Landowner Perspectives on Afforestation for Carbon Sequestration in Canada's Prairie Provinces

R.A. Smith, B.L. McFarlane,
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ABSTRACT

This study examined landowner attitudes toward participating in an afforestation program for the purpose of carbon sequestration and the elements necessary for the success of such a program. Data were collected by means of focus groups and a literature review. Seven focus groups of private landowners met for discussion in Manitoba, Saskatchewan, and Alberta in 2003. Participants identified several potential benefits of afforestation such as ecosystem benefits, potential income, and intergenerational benefits. However, many drawbacks and barriers were also identified, including unknown opportunity cost, time involved in establishing and growing trees, lack of technical knowledge, and ownership and financial issues. Furthermore, the findings suggested that a successful afforestation program would have to consider flexible incentive packages that might include opportunity cost, tax incentives, risk-sharing arrangements, long-term commitment by government and landowners, and the need for information and infrastructure support. A regionally differentiated program would be necessary to account for microclimate and ecosystem differences and regional differences in distance from delivery centers, markets, and support infrastructure. The contingent aspects of an afforestation program include the potential role of carbon credit accounting, cooperative development for both acreage and infrastructure development, and the uncertainty of timber markets in the future. Finally, a need for the development of mechanisms for parallel research, program delivery, and monitoring was identified. These mechanisms must allow for increased and appropriate afforestation-related research, a variety of program delivery models, and monitoring techniques that are both participatory and reciprocal with program development.

RÉSUMÉ

Cette étude consistait à examiner l'attitude des propriétaires fonciers concernant leur éventuelle participation à un programme de boisement visant à séquestrer le carbone et à analyser les éléments qui seraient nécessaires au succès d'un tel programme. Les données ont été recueillies par l'intermédiaire de groupes de consultation et d'une analyse documentaire. Sept groupes de consultation, constitués de propriétaires fonciers, se sont réunis au Manitoba, en Saskatchewan et en Alberta en 2003. Les participants ont reconnu plusieurs bénéfices potentiels attribuables au boisement tels que des retombées écologiques positives, des revenus potentiels et des bénéfices prévisibles pour les générations à venir. Plusieurs inconvénients et plusieurs obstacles ont cependant également été identifiés, notamment les manques à gagner difficiles à chiffrer, le temps passé à planter et à cultiver les arbres, le manque de connaissances techniques et les questions liées à la propriété et aux finances. Les résultats de l'étude montrent de plus qu'un programme de boisement, pour réussir, devrait envisager des ensembles flexibles de mesures d'encouragement qui pourraient notamment inclure le remboursement

des manques à gagner, des incitatifs fiscaux, des ententes basées sur le partage des risques, des engagements à long terme par le gouvernement et les propriétaires fonciers, des mesures d'information et un soutien au niveau des infrastructures. Il serait nécessaire d'adapter le programme à chaque région afin de tenir compte de la spécificité des microclimats et des écosystèmes locaux ainsi que des différences régionales pour ce qui est de l'éloignement des centres d'approvisionnement, des marchés et de l'infrastructure de soutien. Les aspects corollaires d'un programme de boisement comprennent le rôle possible de la comptabilisation des crédits de carbone, la mise en place de collaborations pour le développement des surfaces et des infrastructures et l'incertitude associée aux fluctuations futures du marché du bois. Finalement, l'étude a permis de mettre en évidence le besoin d'élaborer des mécanismes favorisant la recherche parallèle, l'exécution des programmes et la surveillance. Ces mécanismes doivent favoriser davantage de travaux de recherche ciblés dans le domaine du boisement, divers modèles d'exécution des programmes et des techniques de surveillance participatives et concurrentes à l'élaboration des programmes.

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The Feasibility Assessment of Afforestation for Carbon Sequestration (FAACS) initiative, funded by Natural Resources Canada under Action Plan 2000, is designed to investigate eligible carbon sequestration activity within the Kyoto Protocol. FAACS research focuses primarily on private land, and current efforts include improving land assessment data and information relevant to afforestation, developing carbon accounting tools for afforestation, assessing policy issues (related to potential program design, incentives, and co-benefits), and establishing a network of afforestation pilot projects involving different levels of government and interested environmental and nongovernmental organizations and private sector partners.

The Manitoba Forestry Association, a nonprofit educational organization based in Winnipeg, Manitoba, established a collaborative research partnership in November of 2002 with the Canadian Forest Service (Northern Forestry Centre) in Edmonton, Alberta, to deliver a FAACS pilot project for the Prairie provinces. This prairie-centered pilot project is one of five across Canada under the federal FAACS initiative, each separately designed and conducted by various organizations.

This report outlines the results obtained from a series of seven focus group sessions conducted across Manitoba, Saskatchewan, and Alberta under the FAACS pilot project. The overall objectives of these focus group sessions were to determine landowner attitudes toward participating in an afforestation program for the purpose of carbon sequestration and to determine what characteristics the program should have to attract landowner interest.

Afforestation: General Considerations

Afforestation is defined as the planting of trees on land that has not supported trees for a significant period of time (beyond 50 years) and that currently has a primary purpose of agricultural production or represents marginal or idle land in an agricultural setting.

Afforestation programs have been instituted by governments and businesses for many decades in different regions of the world. In parts of western and southern Europe, where population pressures and a limited land base present challenges, afforestation programs have been in effect for more than a century. The reasons for planting trees on land that has not been recently forested range from agricultural production purposes in the case of Israel and other Mediterranean countries (Ginsberg 2002) to a supplanting of agricultural production in Mexico, western Europe, and the Nordic countries (Sheinbaum and Masera 2000). All of these are large-scale, centrally organized afforestation schemes.

There are also esthetic and ecological reasons for afforestation. Urban municipalities in Canada and the United States have had some of the most significant afforestation schemes (in terms of area planted) to date. In western Canada, the Prairie Farm Rehabilitation Administration (PFRA) initiated tree-planting programs in the 1930s, primarily for shelterbelt purposes, and this practice continues today. More recently, planting trees on farmland has become a reasonable alternative for several large forestry companies (Brunnette, V. 2002. Al-Pac's poplar farming program: a report of the potential community benefits of proposed agriculture land purchase and land lease options. Unpubl. rep.). Afforestation efforts have also been initiated to stabilize fragile soil, to protect riparian areas, and to mitigate the effects of wind. A recent review of the literature reveals that, in recognition of many of these benefits, incentives for afforestation are being developed in many areas of the world including Latin America, Australia, Asia, Africa, and Europe (Gilsenan, R. 2003. Incentives to expand forest cover: a framework for Canada [Phase 1]. The Feasibility Assessment of Afforestation for Carbon Sequestration (FAACS). Manitoba Forestry Association, Winnipeg, MB. Unpubl. rep.).

Recently, afforestation programs have been proposed for carbon management purposes. The concentration of atmospheric carbon dioxide (CO_2) can be reduced by an increase in the terrestrial ecosystems that serve as sinks for CO_2. The forestry activities listed in Table 1, including afforestation, can increase carbon storage, maintain existing carbon storage, or reduce carbon emissions related to energy use (Richards et al. 1997). Afforestation is

unique because it specifically refers to the planting of trees on land that has not recently been forested. While this does increase overall forested area, it poses some challenges because of the different degrees of suitability of land for trees. The research project reported here deals specifically with afforestation, but carbon management techniques are also available within agricultural practices. The trade-offs between the afforestation of agricultural land and the use of agricultural practices for carbon management are discussed in the Results section of this report.

Table 1. Land-use and forestry practices to manage carbon (C)[a]

	Main objective		
Practice	Increase C storage	Maintain C storage	Reduce C emissions from energy (fossil fuel) use
Afforestation	X		
Agroforestry	X	X	X
Biomass for energy			X
Breeding or genetics	X	X	
Disease control		X	
Fertilization	X		
Fire control		X	
Herbivore control		X	
Improvements in drainage	X		
Improvements in regeneration	X		
Increased forest products	X	X	X
Insect control		X	
Irrigation	X		
Longer rotation	X		
Preservation of forests		X	
Recycling of wood products		X	X
Reduced-impact logging		X	
Reforestation	X		
Salvage of dead biomass		X	
Shade trees			X
Shelterbelts		X	X
Soil management	X	X	
Stocking control (thinning, etc.)	X		

[a]Adapted from Richards et al. (1997).

Role of Afforestation in Greenhouse Gas Mitigation

Forest ecosystems sequester carbon, through the process of photosynthesis, during the growth stage of both trees and understory species. Forest carbon sinks have a significant potential to mitigate the rise in mean global temperatures caused by the increase in atmospheric CO_2 concentrations (IPCC 2001). Roughly 8 Gt of carbon are released into the atmosphere each year by fossil fuel burning and deforestation; plant growth on land absorbs about 2.5 Gt of carbon each year worldwide. Overall, the world's forests store two-thirds of all terrestrial carbon, and the Intergovernmental Panel on Climate Change (IPCC 2001) estimates that preservation, reforestation, and afforestation activities could sequester an additional 60–87 Gt of carbon by 2050.

Forest ecosystems transfer carbon from the air into plant tissue and eventually into the soil. Over time, a greater proportion of the carbon is accumulated as decaying plant material in the soil than as tree biomass (Fig. 1). The boreal forest (of significance to the research reported here) contains roughly seven to eight times as much carbon in the soil as it does in trees. Temperate and tropical forests have much lower soil–tree ratios and can act as carbon sources if respiration outpaces photosynthesis. Disease outbreaks, insect outbreaks, and forest fires can turn forests from carbon sinks into carbon sources, but boreal forests have much greater resilience as sinks.

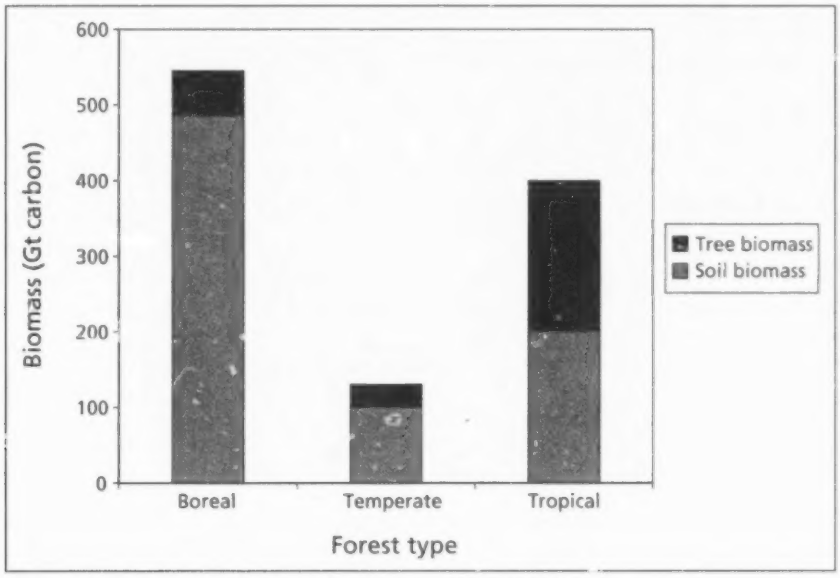

Figure 1. Forest carbon pools. Source: IPCC (2000).

There is currently a good deal of debate about the science of forest ecosystems as carbon sinks (Yamagata and Alexandrov 2001; Pelley 2003). Whether forests act as sinks or sources of carbon depends on many factors operating within each forested region, including the severity of insect or disease outbreak, fire occurrence, forest age structure, and biomass ratio. According to the Integrated Terrestrial Carbon Cycle Model, based at the University of Toronto and driven by remote sensing data, Canada's forests absorb about 50 Mt of carbon per year, although this model shows that carbon stores have declined over the past two decades because of increasing levels of fire and insect disturbance. The Carbon Budget Model of the Canadian forest sector, driven by detailed on-the-ground inventories of forest biomass and the property of the Canadian Forest Service, shows that Canada's forests sequestered roughly 250 Mt of carbon annually in the early part of the 20th century but between 1985 and 1989 released roughly 70 Mt of carbon annually because of fire and insect disturbance (Pelley 2003). Environment Canada has stated that forest and agricultural carbon sinks will account for 10–15% of Canada's effort to reach its Kyoto Protocol target (Environment Canada 2002). In June 2003, the Government of Canada added $12 million to a new carbon sink research program to study these issues.

Role of Afforestation in Greenhouse Gas Mitigation in Canada

Despite the debate over the accounting of carbon sources and sinks in Canada's forest ecosystems, afforestation in the prairie regions offers potential for carbon sequestration over and above current land use in many regions. Canada has agreed to a 6% reduction in CO_2 emissions, relative to 1990 levels, by 2012 with its signing of the

Kyoto Protocol to the United Nations Framework Convention on Climate Change (Government of Canada. 2004. Climate Change. Accessed 29 October 2004. http://www.climatechange.gc.ca/). The compliance period, 2008–2012, is the period in which emissions accounting will be done; Canada will use a range of afforestation, reforestation, and other land-use strategies to sequester carbon and thereby offset some of its emissions.

The Kyoto Protocol allows countries to claim as a credit any carbon sequestered as a result of afforestation and reforestation since 1990, whereas carbon lost as a result of deforestation will count as a debit (Canadian Forest Service. 1998. Forest sector table foundation paper. National Climate Change Process. Ottawa, ON. Unpubl. Rep.). Van Kooten et al. (2000) have discussed several important interpretations of the Kyoto Protocol relevant to afforestation issues. Notably, the difficulty with inventory measurement will mean that measures such as the mean annual increment may be used to determine carbon uptake. There is also the potential that only the commercial (and measurable) component of trees will be counted, so changes in soil carbon may be ignored. This would have the greatest implication for afforestation programs in boreal forest regions.

Most countries have not adopted large-scale afforestation programs for carbon sequestration to date, which will have important consequences for the first compliance period. For most temperate forests such as those found in Scandinavia, Russia, much of the United States, and Canada, the increase in biomass over the first two decades after planting is usually very small (van Kooten et al. 2000). The exceptions are short-rotation woody crops and high-yielding hardwood species such as hybrid poplar (genus *Populus*). In many instances, growth tables do not even begin until the third or fourth decade. Therefore, measured carbon uptake from current afforestation efforts for the first compliance period (5 years from the present) is likely to be small. The planting of more natural, commercially viable species appears to be an intermediate-term strategy rather than a short-term solution to commitments under the Kyoto Protocol. The planting of hybrid poplar, which has short rotation periods (12–20 years), is more of a short-term solution, but planting such species can result in adverse environmental consequences (because of monoculture crops, intensive establishment methods, etc.). Futhermore, planting trees affects more than simply carbon uptake by forest biomass, and the carbon balance that remains in soil and in forest products largely determines the success of carbon sequestration activities. Wood products can substitute for fossil fuels (replacing large carbon emissions), and wood products can serve as carbon sinks for a long period of time (degrading very slowly). Policies oriented toward greater substitution of wood for nonwood products (e.g., in construction) and greater use of wood products in general also improve carbon balances (van Kooten et al. 2000). Afforestation with commercially viable species may reduce the price of wood products for such uses, and plantation forests can be a cost-effective means of sequestering carbon.

In 1990, Canadian emissions of CO_2 amounted to 162.5×10^6 metric tons (t) of carbon, and in 1996, emissions amounted to 182.4×10^6 t carbon. Business-as-usual scenarios project annual emissions to remain stable for a short period and then rise to 203.2×10^6 t in 2010 and 225–230 $\times 10^6$ t in 2020 (van Kooten et al. 2000). To meet its Kyoto Protocol target, Canadian emissions must be roughly 25% lower than that expected in the commitment period. A large part of Canada's commitment (about 25%) will potentially come from afforestation strategies across the country (Canadian Forest Service. 1998. Forest sector table foundation paper. National Climate Change Process. Ottawa, ON. Unpubl. Rep.). Some of this afforestation will occur on public land, and, of concern to the research reported here, a good deal will occur on private agricultural land.

This inquiry used a sequential mixed-method design, as outlined by Mason (1998) and Tashakkori and Teddlie (1998), involving qualitative methods and different data collection activities at different stages. Such a combination of methods allows for the possible emergence of contradictions and fresh perspectives that might not be revealed by one method of investigation alone (Mason 1998). In this case, mixed methods added scope and breadth to the study and provided the opportunity to triangulate results (Yin 1994). The two data collection methods for this study were focus groups for primary data collection in the first stage of the work and a literature search for secondary data collection in the second stage. Figure 2 shows the different stages and methods for each.

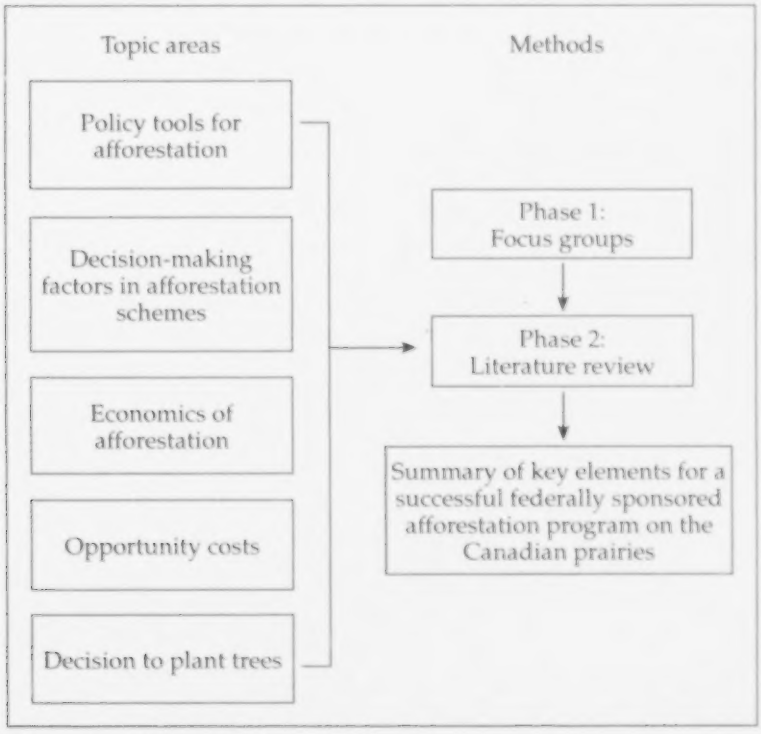
Topic areas
Methods
Policy tools for afforestation
Decision-making factors in afforestation schemes
Economics of afforestation
Opportunity costs
Decision to plant trees
Phase 1: Focus groups
Phase 2: Literature review
Summary of key elements for a successful federally sponsored afforestation program on the Canadian prairies

Figure 2. The research process.

Focus Group Design

Phase 1 of the research included the design and conduct of focus groups. Focus groups typically have five characteristics: (1) people who (2) possess certain characteristics and (3) provide data (4) of a qualitative nature (5) in a focused discussion (Krueger 1988). Focus groups produce information resulting from interactions between group members. Participants can influence each other, learn from each other, and shape attitudes and opinions. At best, focus groups can ensure that researchers have a more complete picture of complex issues associated with a particular topic. Babbie (2001) noted that the focus group format has several advantages: it has flexibility, a high face validity, and speedy results; it is a socially oriented research method capturing real-life data in a social environment; and it is low in cost. These strengths are associated with certain drawbacks, however. It is often time-consuming and difficult to analyze the data, it is more difficult to assemble a group than to conduct a single interview, and the success of group discussion often hinges on the skills of a professional facilitator.

The focus group sessions for this study were designed so that each was conducted in a similar fashion with a common template as a guide (Appendix 1). A key-informant workshop was held to test the template before any focus groups were convened. During the initial project development and testing, the project steering committee determined that a two-pronged approach would best cover the range of issues that were likely to come up during discussions with focus group participants. In an effort to not limit the range of discussion, participants were asked to consider both small-scale or conservation-type afforestation and large-scale or commercial, plantation-type afforestation. These two categories were first introduced during a general discussion of the benefits, drawbacks, and challenges of an afforestation program. Then, probing questions were used to generate further discussion, first about small-scale afforestation and then about large-scale afforestation. The discussion concluded with a review of the important themes and mention of any important points not already discussed.

The introduction to afforestation was a significant part of each focus group and led to discussion of many of the issues. The introductory comments were designed to give participants some basic background information about the FAACS initiative and a common working definition of small-scale and large-scale afforestation. After these introductory remarks, those in attendance were invited to participate in an extensive discussion about the benefits, drawbacks, challenges, and barriers associated with afforestation initiatives in their farming region.

For the purpose of the focus groups, small-scale afforestation referred to small (generally less than 10 acres [4 ha]) plantings of trees on marginal land, shelterbelt planting, and planting for conservation purposes such as slope stabilization and erosion prevention. It was deemed necessary to cover this aspect of afforestation in juxtaposition with the commercial planting of trees in order to achieve significant discussion of afforestation co-benefits. Large-scale afforestation referred to larger block planting of trees, on areas of greater than 10 acres, with the primary intent of producing harvestable qualities and quantities of wood. The probing questions used for this section focused on species selection, marketing and harvesting issues, and concerns about establishment and maintenance of large-scale plantations.

Focus Group Process

A detailed agenda containing the questions for discussion was mailed to each participant before the session (see Appendix 1) to provide further information about afforestation and to give the participant time to think about answers to the specific questions.

Each session began with the facilitator covering the day's agenda and introducing the topic of afforestation. Then the goals and objectives of the focus group research were explained. Each focus group started at roughly 1030 and broke for lunch at 1200 or 1215. The afternoon began with a discussion of small-scale and then large-scale afforestation issues. Each discussion lasted about 45 min, and the session concluded around 1430.

The facilitators made use of individual handouts for each section, which provided information on a particular topic, questions regarding the topic, and space to write responses. These handouts were not collected, and the participants usually took them home for their own reference. A final handout was distributed at the end of the day, which asked for any further thoughts. This handout was either handed back or mailed or faxed back later.

Data Collection and Confidentiality Issues

The focus groups were conducted in such a way to ensure the anonymity of participants. The participants were also told that they were free to answer as many or as few questions as they wished and were not obliged to answer any particular question or participate in any discussion with which they did not feel comfortable.

The data were collected by both tape recorder and handwritten notes and were transcribed to electronic files at a later date. A list of the participants' addresses was collected at each of the seven focus groups. This information allowed the researchers to follow up with participants if needed and to send complimentary copies of the final report. During the handwritten transcription of each workshop, the names of participants were either coded (when specific comments were attributed to certain people) or omitted altogether.

Selection of Participants

Seven focus groups were held throughout the Prairie provinces: three in Manitoba, two in Saskatchewan, and two in Alberta. In Manitoba, the sessions were held in La Broquerie, Brandon, and Dauphin; in Saskatchewan, Yorkton and Saskatoon; and in Alberta, Athabasca and Peace River. Generally, each site was the most central location for the participants, some of whom had to travel for up to 2 or 3 hours to reach the location. Three sites were selected for Manitoba mainly for logistic and familiarity with local provincial government staff. In Saskatchewan and Alberta, organizers relied more on agricultural representatives and government extension officers as initial points of contact to develop participant lists.

The participants were selected on the basis of their geographic proximity to the selected sites and for diversity of participants in terms of farm size, farming type, interest in afforestation, and previous personal experience with forestry-related issues. The groups also included participants who were not landowners: technical experts in afforestation and woodlot management, local municipal officials, local agrologists, and local agricultural representatives. Typically, a maximum of two or three nonlandowner participants would attend any one focus group, along with 10 local landowners, on average. The two Alberta focus groups included industry representatives among the nonlandowner participants. These representatives came from Alberta Pacific and Daishowa-Marubeni International Ltd., for the Athabasca and Peace River focus groups, respectively. Participants were identified through purposive sampling and through existing Manitoba Forestry Association contacts. Agricultural representatives in Manitoba and Saskatchewan provided lists of eligible contacts to generate the necessary cross-section of farm types, interests, and experience with afforestation. In Alberta, a woodlot management specialist was able to provide similar lists for the Athabasca and Peace River regions.

Because of the purposive sampling method and the relatively homogeneous nature of the participants, results from the focus groups should not be generalized to the larger population of private landowners. In particular, participants were selected partially on the basis of their experience with afforestation or their interest in becoming involved in afforestation, and might not be representative of the general population in this regard. Each participant received an honorarium of $75 for participation.

Data Analysis

The detailed focus group results were summarized and organized thematically (Appendix 2). Many comments and issues were raised repeatedly in different sessions, which provided a basis for the thematic approach. Appendix 2 provides details and notes for each topic, and quotations have been included where appropriate. The notes section of Appendix 2 summarizes comments made during the focus groups and was used to develop the themes discussed below. Data analysis involved compiling the recordings and written information for each focus group session and summarizing the discussion. Care was taken to use the actual words of participants as much as possible, while crafting the language of the discussion into a coherent summary. This strategy, commonly known as a representative anecdote (Spector and Kitsuse 1977), gives voice to points of view through the description of central issues or causes of concern. The anecdote must be complex enough to represent the subject of concern but also simple enough to allow the subject matter to be reduced to an easily understandable form. These representative anecdotes were then compared between focus groups to explore and document apparent differences in the way each question was addressed. There was no weighting of themes, nor was this possible given the research method. The objective of the thematic approach is to provide background for the essential elements needed in a federal afforestation program.

Following the design of the focus group template, these results are organized according to the potential benefits, the drawbacks, and the barriers to afforestation. The results from the discussion of small-scale and large-scale approaches follow.

Benefits

Ecosystem Benefits

The ecosystem benefits noted by the majority of participants included an increase in biodiversity, the provision of windbreaks through the use of either shelterbelt or larger block planting, and the prevention of soil erosion through the stabilization properties of mature trees. A comment repeated by many participants from Saskatchewan was the potential for increased snow retention and reduction of wind speed with both large- and small-scale plantings.

Wildlife benefits were expected to come in the form of increased habitat for ungulates and bird species. The connection of existing and newly treed areas would also provide wildlife corridors and increase migration habitat. It was observed that some marginal or abandoned lands in remote areas or, conversely, very close to urban areas are currently sources of noxious weeds and would benefit from the weed control associated with a managed afforestation scheme.

Afforested areas can act as natural filters for nutrient runoff in riparian or fragile areas. Improvements in moisture content and soil fertility in a well-managed plantation would also benefit soil quality in drier regions of the prairies (e.g., the "soil husbandry potential" of afforestation was noted by focus group 5, held in Saskatoon, Saskatchewan). In addition, it was noted that there are probably microclimate benefits over the long term that would be difficult to quantify or predict. One of the most immediate benefits is carbon sequestration, with both local and extended impacts.

Potential Income Benefits

Most participants at each focus group noted, with caution, that there is income potential, over the long term, with the harvest of afforested areas. Many participants observed that afforestation is a high-risk investment because of uncertainty with regard to future markets. The potential for an income based on carbon credits was also discussed by each focus group. It was noted that carbon trading has begun on both the Chicago and Winnipeg futures markets and that there would be some potential for annual income in this regard. Participants said that any afforestation program should account for carbon credits and find a way to provide the returns to individual landowners.

The potential for diversification of income would eliminate some of the variability in annual returns from more traditional commodity crops. For afforestation on good soil, the potential reduction of input costs, compared with continued long-term conventional agriculture, would also provide income benefits. A participant in focus group 5 asserted that "afforestation on larger scales has the potential to improve the economies of whole regions." Potential improvement in property values as a result of an increase in trees was also noted in the majority of sessions.

Intergenerational Benefits

Many of the participants stated that afforestation initiatives must recognize the average age (nearing 60 years in most areas) of farmers across the prairies. Comments seemed to either emphasize the value of afforestation as a way of keeping land within families and providing a means for transition of family resources from one generation to another or emphasize the need for current young farmers to take advantage of afforestation programs because they are potentially the only ones who will see any income benefit from the sale of trees. Many participants expressed this idea in the form of an analogy to registered retirement savings plans (RRSPs): afforestation would provide retirement income for the current generation of farmers and maintain land ownership and income support for the upcoming generation.

Structural Benefits (Agriculture)

A good deal of discussion focused on the potential changes to the current structure of the agricultural industry on the Canadian prairies. The changes will occur regardless of a particular afforestation initiative, but there was a lot of

interest in afforestation as a potential mitigator of negative trends. In particular, the potential for increasing the stability of income is often seen as one way to reduce vulnerability to cycles in commodity prices, and the potential for carbon credit compensation was discussed as a tool to form new industry–landowner and government–landowner partnerships. With regard to adapting to future climate changes and predicted growing conditions, the use of trees as a new type of "crop" was mentioned as a good alternative to current grain crops and some forage crops.

Drawbacks

Opportunity Cost

The opportunity cost of afforestation was identified as the biggest drawback by almost every participant. Afforestation will usually occur on lands that are productive in some manner or that have some value to the landowner for rental, grazing, or production of a commodity crop; afforestation will therefore result in less realized income in the short term. Participants stated that this factor would largely determine which lands could be used for afforestation purposes, noting that many active farmers would not be able to take highly productive lands away from producing annual income unless risk minimization measures were in place. Some participants were able to put a dollar value range on a particular piece of property that they owned, but this usually varied year to year and was difficult to project into the future beyond 3 to 5 years. Ongoing requirements to meet land taxes and land payments would also have to be accounted for in any afforestation initiative.

A second important issue was future opportunity cost related to changes in markets, technology, or crops that farmers would be unable to take advantage of if land were tied up in an afforestation program. This concern was repeated in every session, and many participants stated that any afforestation program would have to be flexible and competitive with future land uses to offset opportunity cost in future years.

Some of the landowners with experience in afforestation and reforestation stated that the return on investment in harvestable trees is linked to the quality of the land used for afforestation. Good-quality soil generally produces more biomass in a shorter period, whereas more marginal soils will not necessarily produce the same quality or quantity of harvestable trees.

The degree of opportunity cost is therefore directly correlated with the potential return on investment. Participants identified two means for return on investment. First, opportunity cost could be recovered with a return on investment at the time of tree maturity and harvest and (or) with annual returns paid to the landholder. Second, annual returns could come in the form of cash payments (as a form of subsidy for environmental protection services), in the form of land rental agreements with government agencies, or in the form of contracts with government agencies, each of which might have different payment options and schedules.

Time Commitment

The length of time required for establishment, maintenance, and growth of trees before they reach a harvestable size was seen as a hindrance by many participants. The reaction to the time commitment was generally due to the difference between current farm and business planning time frames and what would be required for an afforestation initiative. Several older farmers worried that afforestation initiatives on their land would tie up any potential immediate returns should they need to sell part of their land for retirement or other financial needs.

The other concern with the time commitment was the risk of not seeing any return on investment after putting 15–20 years or more into one potential harvest. Many participants said they were less comfortable with this risk than with crops that typically mature in 1 or 2 years. There was also some skepticism that a harvestable quality and quantity of hybrid poplar would be produced in 15 years except under ideal conditions. Saskatchewan participants stated that it could take up to 30 years, even with fast-growing species, and that some of the slower-growing softwood species, which may have more value, could take 50 years or longer. The variation in potential time frames was a concern at most sessions because most landowners do not usually plan with such uncertainty.

Establishment and Maintenance Requirements

The unique requirements for the establishment and maintenance of trees were seen as a drawback by many landowners. The special equipment needed to plant seedlings (e.g., small tractors, planters, small cultivators,

mulch applicators) is not readily available to most landowners, and the additional expense of this equipment would be prohibitive. There was some discussion of solutions to this problem, in the form of cooperative arrangements or the inclusion of equipment rentals in an incentive package.

The high labor requirement during the planting process and for subsequent maintenance throughout the establishment period was highlighted as a deterrent by many participants. Many of these labor needs would be concurrent with existing requirements for seeding and field preparation (for grain growers) and calving (for many livestock producers). Particularly for small-scale efforts and in areas where access to equipment is poor, manual labor would probably be needed, and landowners would have to hire additional people during planting.

Weed control was cited as one of the biggest drawbacks to any planting initiative. During the establishment period (the first 3–5 years), weeds must be controlled with either mulch, spraying, the use of cover crops, or cultivation, all of which require both special equipment and time. Finally, the knowledge and technical requirements for proper care and maintenance were not well known among the participants, although it was recognized that a different management scheme from that for conventional crops would be needed.

Changes in Attitude

The requirements for attitudinal change on the part of potential program participants were highlighted in all of the sessions. It was recognized that many landowners, especially those who are not normally innovators or early adopters, might be reluctant to convert agricultural land to trees. In many cases, land now used for agriculture, especially along the edges of the boreal forest and parkland regions, had to be cleared of trees by earlier family generations. One participant commented that "my grandfather would roll in his grave if someone were planting trees in those fields."

Participants also pointed out that farmers generally try to distinguish themselves from foresters, and the two industries have not worked closely together in the past. Forestry is commonly thought of as something that is done with idle land, and any agricultural land that has been forested is considered unproductive or can be ignored. A common perception among farmers is that they are working soil and planting crops that have tangible and immediate returns. The required change in both public and self-perception was a commonly mentioned theme in the focus groups and could represent a potential drawback if many landowners are resistant to the idea of planting trees as a form of agriculture.

Ecosystem Changes

Although afforestation yields many ecosystem benefits, several drawbacks were also noted. For example, the potential increase in available wildlife habitat was seen as having some negative impacts. Participants in most focus groups commented that the proliferation of deer could become a nuisance and that an increase in the deer population would require, at a minimum, more fencing. It was also mentioned that increased forest acreage could become a refuge for pests and noxious weeds; in fact, many farmers currently remove trees in forested areas to eliminate this problem. There was discussion about the potential problems associated with monoculture afforestation, analogous to monoculture cropping methods. Some participants suggested that mixed stands and polyculture plantings would provide better biodiversity and eliminate the risk of pest or disease outbreaks.

The increased risk of forest fire as a result of an increase in forest area was seen as a potential insurance problem and a large risk factor for a long-term investment in a stand of trees. Some Manitoba participants discussed the potential for new wildlife diseases or the proliferation of diseases such as tuberculosis, which could be spread through larger wildlife populations in increased habitat.

Barriers and Challenges

Carbon Credit Accounting

The issue of potential carbon credits was raised many times in each session. Most people felt that there was great opportunity for remuneration from carbon credits but that a lot of information would be needed before they could speculate further. Carbon trading has already begun on the Winnipeg and Chicago futures markets, but the valuation of credits and the assignation of credits are still largely unknown. There was speculation that carbon credits might go to the federal government, especially if a federal department sponsored the afforestation program. There was

an expressed desire that carbon credits be assigned to individual landowners, such that they would receive compensation for the husbandry of carbon sinks. In one Saskatchewan session, participants suggested that cooperatives among private landowners would allow them to offer aggregate numbers of carbon credits, to the extent that this might be of interest to industry.

Many participants felt that the issue of carbon credits would have to be fully realized in an accounting process before an afforestation program could begin. Several points were raised: If carbon credits are given fair value and a method can be developed whereby individual landowners receive compensation for their own carbon sinks, then farmers would have an incentive to participate in a large-scale program. Participants were worried about liability issues and speculated that they might be held responsible for carbon sources as a result of farming activity. The ownership of carbon credits was an important issue, tied to the ownership of the trees, and retention of ownership by private landholders was critical to almost every participant. The relative roles of industry and government in the trading of carbon credits were also discussed; these roles would have to be defined before many of participants would be willing to enter a federal afforestation program.

Information Needs

The need for information was probably the most cited and most discussed issue at each session. The idea of afforestation, on its own, was generally well received, but participants identified a variety of information that they would need before they could make a committment. Most participants lacked the technical information needed to plant trees (see next theme). Participants also wanted definitive answers to some of the economic questions about an afforestation initiative on private lands. They wanted to know how much it would cost to establish an afforested area, given the variety of species available and their growing and maintenance conditions; what the expected return on investment would be, given the time frames and potential markets; and what other options for profit-making ventures there were, aside from selling to existing lumber or pulp mills.

One particular concern was the lack of readily available (or existing) information about the suitability of new hybrid species for lumber or pulp. In other words, many participants wanted to know that the trees they would be planting now would be suitable for a particular end market in 20 or more years. Several participants stated that they would benefit from seeing some sample business plans for afforestation ventures (of different sizes), and others stated that some "best and worst practices" manuals would help people who are interested in afforestation. Additionally, some practical and easy-to-use grower's manuals would help during the establishment and maintenance periods. No attempt was made to identify whether this information was currently available, but several landowners with experience in afforestation stated that they began largely on their own and that little information had been accessible.

Technical Knowledge

The need for more technical information, as well as more public availability of this information, was discussed during most sessions. Several of the landowners with experience in afforestation and several of the extension agents from government departments stated that there is little ecoregion-specific information about species suitability and potential growth rates. Many participants contributed personal knowledge from experience on their own properties about the suitability and growth rates of different tree species (the majority stating that, for many species, realistic time lines for tree maturity would be at least 25% longer than what is often reported from research stations). Particular microclimates and soil conditions would require a precise planting scheme, and many participants felt that good information about these factors would eliminate some risk.

Some participants stated that land assessments (analogous to timber cruises) would be beneficial to landowners who lacked experience with afforestation. Such assessments would help landowners to determine which species would be best suited to conditions on their property and whether it would be appropriate for them to initiate an afforestation program. Other participants stated that land assessments would help prevent "program milkers", people who would take advantage of financial incentives even if their land is not suited for afforestation.

Ownership Issues

Several particular ownership issues were raised. There was a consensus among all focus group participants that ownership of the land should remain with the current landowners. Many expressed concern that any leasing arrangements

would remove control of the land from their hands and place it with the leasee (generally assumed to be the federal government). Participants also explained that ownership of the trees should rest with the landowners, unless the incentive scheme was such that annual incomes would be beneficial in and of themselves. Conservation easements and caveats on the land were seen as problems, and a general consensus among the farmers was that previous experience in Canada and the United States had proved that these set-asides do not always benefit farmers in the long run.

As explained above, carbon credits should also belong to the landowners, and participants felt that relinquishing control of these credits could mean relinquishing control of a new source of income. A final issue about ownership was the "first right of veto." In all sessions, participants asked whether landowners could decide to change the land use, from forestry back to an agricultural crop, if an opportunity presented itself. Most participants wanted the first right of veto so that they would not be locked into an afforestation scheme if they would benefit to a much greater extent from some other land use.

A continuum generally emerged through the focus group sessions whereby ownership options ranged from an absolute lease on the land through a government program (similar to the Conservation Reserve Program in the United States) to landowners assuming complete risk for expenses, labor, and maintenance and receiving all benefits from the sale of wood or carbon credits. Recognizing this continuum was useful for participants, but many were reluctant to indicate a preference for one particular point along the continuum, because of a lack of information.

Financial Incentives

Financial incentives for participation in an afforestation scheme were discussed in two respects: compensation per year per hectare and tax credit programs. The issue of what land was worth (per year or per hectare) was introduced by the facilitator during each session, but many participants were reluctant to discuss specific numbers. A range of values was discussed for particular land types (e.g., pasture land, forage land, grain or cereal cropland, fragile land), and these values varied depending on the particular region of the prairies where the landowners resided. The concept of opportunity cost was raised by almost every focus group, and participants stated that identifying a dollar figure for the opportunity cost on a particular piece of property would depend a great deal on where the land was located, the soil type, distance from certain markets, changing values for land rental, land speculation in areas closer to urban centers, and even climate change. The opportunity cost would probably vary from year to year, and it would be difficult to project a dollar value beyond a 5-year horizon.

The financial incentives that would attract a majority of landowners were annual returns per year or per acre. Annual returns from a government-sponsored program in the form of cash subsidies, flexible contracts, or land rental agreements, would appeal to a broader base of private landowners. These options would help alleviate some of the risk associated with transition to a new type of crop and acquisition of the new techniques, skills, and machinery required for afforestation. It would also allow landowners to continue meeting current payment obligations for operations and capital investments.

Although a larger return on investment could be obtained from tree harvest and sale than from more traditional farming activities, the long time horizon makes this option more risky and requires a higher degree of initial capitalization. Landowners who are less risk averse or who have idle land with some flexibility in their annual income would be more likely to take advantage of a potential long-term return on investment.

Tax incentives were also discussed by each focus group, and there was a general consensus that such incentives could be effective in getting participants to change their current land use. Municipal land taxes and income taxes were both discussed as barriers to any large-scale afforestation scheme. Participants expressed a variety of opinions about land taxes, some stating that they would not want to see fewer tax dollars go the municipalities because of conversion of land to forest (which is currently assessed at less than agricultural land), and others insisting that lowering the land taxes would encourage them to participate in an afforestation program. In terms of income taxes, many participants thought that it would be beneficial to amortize income earned from the sale of trees at maturity over the lifetime of the trees. Although this would be difficult to implement, some way of declaring income for assumed annual returns would be beneficial for most landowners.

Multifaceted Program Approach

Of particular importance to this research was the clear direction from participants in the focus groups that any afforestation program must be multifaceted. Regional differentiation in microclimates, soil types, and economies would mean that a blanket approach for the Canadian prairies as a whole would not work, except for landowners in privileged positions (those with excess owned land or those with enough income from other sources to absorb greater risk). The focus group research was able to identify some of this differentiation (and the corresponding incentives) by region and identify appropriate directions for a potential federal afforestation program in this regard.

Public Education

Public education—both education of private landowners and education of the public at large about the benefits of carbon sequestration—was consistently noted as a challenge for any afforestation program. Participants said that it would be necessary to get their local municipalities involved in a public education initiative that complemented the afforestation program. There was also a suggestion that education programs in schools could promote the hiring of summer students for silviculture training and tree planting.

Small-Scale Afforestation

Defining Marginal Land

Use of the term "marginal land" in the focus group discussions prompted criticism from many participants. Generally, participants could not agree on a clear definition of marginal land, and most felt that the term was a poor descriptor. Some producers said that their existing marginal land was marginal only because of current prices for commodity crops, whereas others said that the marginality of land had more to do with access or suitability for equipment than it did with soil quality. Yet others made the point that there are a variety of crops or uses for different types of land, and land that may be considered marginal for growing grain may do well in pasture. The general consensus was that all land had an opportunity cost and that it was best not to think of so-called marginal land as land having little agricultural value.

The term "fragile land" was identified in several instances as a better description for so-called marginal land. Participants used this term to refer to land that consisted of unstable slopes or that was near sensitive areas (riparian areas, streams, sloughs, hilltops, etc.). The suitability of fragile areas for afforestation was questioned in many sessions, as these areas may be too sensitive for the planting of trees or their soil may be of too poor quality to support adequate tree growth. At the focus group sessions in Saskatchewan, participants stated that there was opportunity for afforestation on rocky land, which offers good-quality soil but is generally too rocky for tillage equipment.

Conservation versus Commercial Planting

Most participants were interested in a small-scale afforestation initiative, one that would not necessarily duplicate existing shelterbelt enhancement programs and that would offer more flexibility than those programs. However, it was also observed that a small-scale initiative would not necessarily provide commercially viable qualities or quantities of harvested wood. Small-scale planting was referred to as conservation planting in several of the sessions, and for many participants this term was more appropriate. Discussion centered on afforestation for the purposes of stabilizing slopes, filling in field corners, lining waterways or buffer riparian areas, and providing esthetic improvements near roadways and houses.

Some interest was expressed in aggregating small-scale plantings so that they would be counted under carbon sequestration schemes or carbon credit programs. It was felt that new shelterbelts, widened fencerows, and conservation plantings could contribute significant tonnage of sequestered carbon and that some method could be devised to account for this. Many participants said they would be interested in a small-scale afforestation initiative with this sort of flexibility, although they had more difficulty imagining their participation in a larger-scale block planting scheme.

Large-Scale Afforestation

Information Needs

The information needs for a large-scale afforestation initiative reflect those mentioned in the "Barriers and Challenges" section above.

Participants emphasized the need for technical information, grower's manuals, business planning scenarios, and manuals or case studies of best and worst practices. The most commonly mentioned need was for information about the economics of any potential afforestation initiative. Participants stated that they needed to see typical accounting figures for different sizes of operations. Essentially, most people would expect an economic argument to be presented before they would agree to participate in any large-scale planting involving an opportunity cost.

A second consistent requirement was the need to know how a potential federal afforestation program would fit with other ongoing or proposed federal programs. Participants also wanted to know how this afforestation initiative would fit with the Kyoto Protocol and what role industry or government partnerships would play in the future (e.g., would industry buy carbon credits from landowners or from a carbon trading body, or would the government act as a mediator, facilitator, or owner of the carbon credits?). Some of this information is already available or can be made publicly available with relative ease, whereas other components still need conceptualization and more effort by policy-makers.

End-Use Scenarios

The potential end use of trees from an afforestation scheme was the subject of speculation. Most participants agreed that it was probably naive to assume that there would be a secure potential market for mature trees in the form of pulp or small-dimensional lumber at any of the existing mills. The mobility of these mills, combined with the fluctuating price and demand for wood, as well as the unknown marketability of new hybrid tree species, makes this sort of speculation very risky. Value-added products and sales of carbon credits were seen as having more potential for a good return on investment.

Some of the experienced woodlot owners in the focus groups offered valuable ideas about woodlot management, polyculture planting, and selective harvesting. Their examples demonstrated how stand management and maintenance can produce returns over a number of years and how niche marketing can provide stable income. These participants were a valuable resource and demonstrated the potential of large-scale afforestation.

Good Soil, Good Trees

At each of the focus groups, participants were asked how they would decide which of their lands they might contribute to an afforestation program. The general consensus was that any large-scale afforestation intended to generate good growth rates and high stand productivity would have to be instituted on good-quality soil. The sentiment that "good soil grows good trees and poor soil grows poor trees" was echoed at all of the sessions. Any program that encourages landowners to participate in afforestation for a significant part of their income (i.e., as an alternative to a crop they are currently producing) would have to account for planting on good-quality land with a higher opportunity cost. Many participants noted that large areas of afforestation could not be achieved on only marginal (or fragile) land.

LITERATURE SUPPORT

Policy Tools

Many policy tools can be used to encourage afforestation schemes on private land, but there is probably no universal policy tool that is the best or most accepted or most effective in every situation. Because of differing microclimate, land value, agricultural focus, government emphasis, and desired outcome (in terms of acres of afforested land), various policy tools can be used simultaneously. Richards et al. (1997) discussed some of the policy options for enhancing carbon sequestration in forest ecosystems, generally with afforestation management (see Table 2).

Table 2. Policy tools to encourage afforestation[a]

Mechanism	Policy tool	Detail
Direct control	Regulation and fiscal expenditure	Afforestation on government land
		Government-run afforestation on leased land
		Input regulation to existing forest ecosystems
		Output regulation of existing and new forested areas
Indirect control	Economic incentives	Taxes
		Subsidies
		Contracts
		Carbon credit markets
	Institutional incentives	Private property rights
		Market reforms
		Education and extension
		Research and development
		Volunteerism and encouragement

[a]Adapted from Richards et al. (1997).

Direct and indirect controls are the two main types of policy mechanisms available to government. Direct control usually involves the government producing (or sequestering) carbon itself or regulating carbon production on public land. Certain afforestation efforts in Canada (e.g., the Canadian Council of Forest Ministers Forest 2020 initiative) are initiated by government.

With indirect controls, government uses economic tools to induce private landowners to increase the stock of carbon on their land. This can be done through afforestation and through changes in land use of existing forested areas (i.e., better management).

Indirect control mechanisms are most relevant to this research as they pertain most directly to private land. Market-based incentives provide a good deal of flexibility to private landowners and can be specifically developed to serve various needs. These economic incentives include taxes, subsidies, contracts, and tradable carbon permits. (Each of these incentives was discussed in the workshops.)

Taxes and subsidies can be used in a variety of ways to encourage the planting of trees on marginal or other agricultural land. Income tax or land tax reprieves can be given to landowners who plant trees, or taxes can be levied on landowners who remove or release carbon from forest stocks. Subsidies can be given as incentives to establish trees on private land. The cost of establishing trees is relatively high, so subsidies, in combination with tax incentives, would be an effective way to encourage participation in an afforestation program.

Two types of contracts may be employed by government as carbon management incentives (Richards et al. 1997). Government agencies may contract with private landowners not to harvest a particular stand of trees, in return for financial gain. Alternatively, government agencies may contract with private landowners to convert marginal or other land to trees. The latter option would be similar to leasing private land, although the responsibilities for managing trees might differ.

Marketable permits represent a promising incentive for private landowners to adopt afforestation schemes. Although such permits are not necessarily the responsibility of government and although new carbon trading markets have been started on public exchanges, there is a potential role for government in setting the overall pool of carbon it wishes to store. Government, like any private entity, can also trade carbon permits, thereby encouraging afforestation on private lands through the incentive of financial return.

Institutional incentives cover a range of needs, including information and research priorities for private landowners, as well as education and extension work. Various government agencies currently have experience and points of contact for such activities within appropriate sectors (e.g., Agriculture and Agri-Food Canada, Canadian Forest Service, Rural Secretariat, PFRA). Participants in each of the focus groups expressed a desire for institutional incentives, but it was felt that any incentive package would likely combine market-based incentives with institutional support incentives.

The establishment (or maintenance) of private property rights in the management of natural resources is important. A link has been established between private property ownership and sustainable resource management (Palmer and Synnott 1993) and between a community or individual's decision-making flexibility and ecological sustainability (Holling 1978; Flora 2001). It is critical that the ownership of private land remain in the hands of the current owners (generally farmers or absentee owners), as they are best able to determine the efficacy and appropriateness of any afforestation scheme over the long term.

Market reform incentives pose a large and complex set of issues that government agencies can mediate to some extent, depending on the circumstance. The sale and market of timber for a variety of uses is currently mediated by government but is generally determined by the global marketplace. If people are to invest in a sustainable afforestation program (yielding a timber product at the end of the rotation), price and market information must be available and somewhat predictable. Uncertainty about future markets for timber products poses a substantial risk for landowners thinking of afforestation, and market support by government could help to reduce that risk.

Extension and education incentives are necessary for afforestation programs. Through extension services, government can provide information and education about land management practices that will improve carbon sequestration and enhance the potential for afforestation on agricultural land. Education services can be provided in a number of ways: on-the-ground training in afforestation techniques for landowners, grower's manuals, site preparation manuals, and business case studies.

Research and development incentives include government funding for research on new tree species, genetic improvement of tree species for a particular region, development of new agroforestry techniques, or development of herbicide, pesticide, and fertilization techniques to enhance productivity. A significant challenge in afforestation on the prairies will be the long rotation periods required, even for hybrid poplar, and research and development work to improve tree productivity will help any afforestation program. Research and development funding can also be directed to projects that improve the efficiency of harvesting and production and that look for new end uses for afforested timber.

Some agencies encourage afforestation and other carbon sequestration options on a voluntary basis (e.g., PFRA's shelterbelt enhancement program), and these options could be converted to a reward or small subsidy basis. Carbon offset projects, which have worked in many regions (Dixon et al. 1993), include the establishment of agroforestry programs in developing countries and the use of private funds to plant trees on private land in the United States and Canada.

Key Decision-Making Factors

Determining the right combination of appropriate policy tools will necessarily depend upon the nature of the desired program, the intended outcome (e.g., number of acres planted across the prairies), legal issues, and previously held relationships among government, its agencies, and private landowners. Several key characteristics of carbon sequestration practices, all relevant and applicable to afforestation specifically, influence the decisions made by both government and private landowners (Table 3). Each of these issues was also raised in the workshops.

Table 3. Key decision-making factors of carbon sequestration practices[a]

Category	Factor
Risk	Timing of carbon uptake
	Capital intensity
	Market risk
	Natural risk
Difficulty of measurement	Need for and ease of establishing a baseline
	Cost of measuring on-site carbon
Importance of discretionary factors	Variability of application
	Potential for innovation in practices

[a]Adapted from Richards et al. (1997).

The risk associated with investment is a significant factor affecting whether an individual landowner decides to afforest private land. Four aspects of the risk presented by carbon sequestration practices are presented in Table 3. The first relates to the timing of carbon uptake that results from afforestation. This carbon uptake can be spread over several decades, or even longer for some tree species, and the financial rewards are consequently spread out over the same period or come at the time of tree maturity. More immediate rewards from carbon uptake would come from the preservation of existing tree stands or from shorter-term agricultural strategies for carbon sequestration. Another risk to the landowner is that payments from a program or even the program itself could be dismantled or discontinued.

The capital intensity of afforestation is also a significant factor in the overall risk of investment. Whereas the capital intensity of less permanent carbon sequestration activities, such as fire control or low-impact logging, is lower, the cost of establishment for afforestation is high and the cost of reversing the decision (i.e., returning the land to agricultural uses) is also high. Most private landowners of concern to this research are farmers and are more accustomed to making land-use decisions on an annual or biannual basis, rather than every 10 or 20 years.

Market risk is another key determinant of the overall risk. Market prices for timber can be easily projected over the short term, and this works well for short-term rotations, but large-scale afforestation is more difficult if landowners are uncertain about long-term timber prices and demand (Richards et al. 1997). One solution is the development of more markets for timber and for multifunctional accounting of carbon benefits (e.g., carbon credits, timber sales, agroforestry, agritourism, "green" energy). Again the projection of markets in energy, tourism, and carbon trading is difficult, but the risk can be spread among various options.

The risk of natural loss also increases the investment risk. Fire and outbreaks of insects and disease in planted forest pose a large risk because of the investment required for establishment and the delay in receiving financial benefit from tree rotation. The risk is concentrated and spread over a time when the financial returns are minimal.

The difficulties of measuring carbon sequestration benefits and of establishing firm guidelines for measurement constitute a further decision-making risk for landowners. Perhaps the greatest problem in measuring the effects of carbon sequestration activity is establishing baseline or reference cases. The construction of a baseline measure involves substantial speculation about the biological and socioeconomic factors affecting carbon sequestration practice. The sequestration potential of marginal or productive agricultural land must be compared with that of afforested land and the carbon emissions as a result of tree establishment discounted. Additionally, a cost–benefit analysis for land uses other than planting trees should be done.

Measurement difficulties also arise when accounting for on-site carbon after afforestation has begun. Various models are available to give a rough approximation, but differences in land quality and management practices will greatly affect the results for individual sites. If landowners are interested in carbon trading with other private businesses or with government, then a reliable measurement tool must be developed.

There are also important discretionary factors in decision-making related to afforestation practices. Because afforestation practices are not well established, relative to practices for common agricultural commodities, there are many variations in management practice and many new techniques that are unfamiliar to most landowners. Most afforestation practices require significant technical expertise, site-specific knowledge, and discretion in application. The potential for managerial and marketing innovation by private landowners is high, however, such that early adopters of afforestation schemes may develop lucrative markets and take advantage of speculative market pricing in the early stages of marketplace development.

Economics of Afforestation for Carbon Sequestration on the Prairies

Van Kooten (2000), van Kooten et al. (2000), and Plantinga and Mauldin (2001) have investigated the economic feasibility of planting trees on agricultural land, through afforestation programs, in western Canada. These studies

examined afforestation on marginal land and used various economic models to show the cost of CO_2 mitigation through afforestation and to determine the probability that afforestation programs would be successful, given their feasibility.

The basic inputs to these economic analyses were economic data on the costs of afforestation and biological data on carbon conversion of trees. The costs included land acquisition, stand establishment, maintenance, and carbon conversion rates reflecting land productivity, tree species composition, and previous land uses. From this information, the average cost per unit of carbon sequestered can be calculated. In an early study Sedjo and Solomon (1989) estimated the cost of offsetting 0.8 Gt of carbon per year through tree planting in temperate forest regions at about US $15/t. Moulton and Richards (1990) conducted a more detailed study in different regions of the United States and found that carbon sequestration costs associated with planting trees ranged from US $8.50/t in the pasture regions of the southern plains to US $41/t for planting on cropland in the cornbelt. The cost variation was related to many factors, notably land rental rates.

The modeling of afforestation costs improves when endogenous costs are included. The cost of enrolling land in an afforestation program is highly variable and will likely become even more variable as more land is enrolled. Parks and Hardie (1995) conducted a thorough analysis that included some of these endogenous costs. Agricultural commodity prices may rise as agricultural land is converted to trees, as may land rental values, tree establishment costs, and opportunity cost. The success of a particular afforestation program will have a reciprocal effect on the costs of carbon sequestration and will affect the range of cost estimates. Parks and Hardie (1995) estimated that with low levels of enrollment in an afforestation program the costs would be similar to those found by Moulton and Richards (1990) and with high levels of enrollment the costs would be 50% higher.

Programs that permit harvesting of timber on enrolled land will alter the cost estimates. Enrollment costs may be lower because landowners receive revenue from the sale of timber, which reduces the amount of compensation they require to divert land from agricultural uses (Plantinga and Mauldin 2000). However, approximately 60% of carbon stored in the merchantable portion of trees is converted to CO_2 during harvesting, with the rest remaining sequestered for long periods in solid wood products and landfills. The net effect of timber harvesting may be to reduce sequestration costs in some regions and increase them in others (Plantinga et al. 1999).

Plantinga and Mauldin (2000) presented evidence that landowners are reluctant to shift land to forest and are slow to respond to changes in the relative net returns to forestry. An important issue is the relative irreversibility of the afforestation decision, coupled with uncertainty about future net returns. Econometric models can capture these effects with data on observed landowner behavior. Plantinga and Mauldin (2000) examined three US regions, using an econometric model to track carbon sequestration costs given this observed landowner behavior. Their cost estimates per ton of carbon sequestered varied depending on the region but were higher than those reported in earlier studies. Incorporating endogenous costs such as rising land values, shifts in land use as a result of future climate change, and changes in commodity prices for agricultural products all tend to drive up the cost of carbon sequestration. The exception may be climate change variables in some regions, and it may become more feasible to convert agricultural land to forest activities as a result of temperature and precipitation changes.

Van Kooten (2000) has studied the economic dynamics of afforestation in northern British Columbia and northern Alberta using "ground-truthed" data from the region. Marginal land was identified from Statistics Canada data. The econometric model showed that, for a cost of $20/t of carbon sequestered, it would be optimal to afforest as much as 50% of the identified marginal agricultural land. This estimate was based on large plantations of hybrid poplar and assumed that many costs (e.g., agricultural commodity price, land prices) were exogenous. Using these assumptions van Kooten estimated that roughly 25% of Canada's annual Kyoto commitment could be met with afforestation in the study region. When the result was extended, hypothetically, to the rest of the available marginal agricultural land in Canada, it was determined that 50–60% of Canada's annual Kyoto commitment could be met through afforestation policies. This is the most optimistic scenario and ignores many real aspects of afforestation over time.

To keep the costs of carbon uptake at a reasonable level, large areas cannot be afforested all at once. On the basis of rising planting costs, van Kooten (2000) estimated that 200 000 ha or less could be planted across Canada in the initial years of an afforestation program and that the area planted would decline over time. This means that by the end of the compliance period, only 15% of Canada's Kyoto commitment could be met by afforestation across all of Canada. Second, many unknown environmental costs could be associated with planting monocultures of hybrid poplar on a large scale, including potential loss of wildlife habitat, especially on noncultivated agricultural land, loss of scenic amenities (although scenic amenities might also be gained, depending on the initial conditions of the agricultural land), and risks of disease outbreaks and fire.

The difficulty in accurately assessing the economic costs and benefits of afforestation relate to the unknown factors in establishing hybrid poplar (or some other species) on a large scale on existing private land. Determining the most appropriate incentives for landowners to grow trees (as described here) will be an iterative process. The outright purchase of agricultural land will not be feasible because of budget limitations (van Kooten 2000), and contracting between landowners and government authorities will not necessarily be consistent or its cost predictable over an extended period. The cost of monitoring tree growth and carbon uptake will be high, and there are currently no institutions in the Prairie provinces that monitor growth and yield. Finally, there is a great deal of uncertainty associated with planting hybrid poplar on a large scale simply because it has not been done previously. There is also uncertainty about the current and future prices of timber products and agricultural products. Thus, speculation on timber profits is combined with speculation on opportunity cost.

Opportunity Cost

The opportunity cost of afforestation schemes on private agricultural land refers to the loss of potential income from agricultural production on that land. This cost is affected by a number of factors, including loss of income from current production, forgone future market opportunities, and changes in resale or appraisal values of the land. A compounding factor is the length of time required for afforested areas to mature: 12–25 years for hybrid poplar and even longer (up to 50 years) for slow-growing tree species. Agricultural producers currently deal with production cycles of 1, 2, or 3 years at most, and market prices are not usually predicted in any quantifiable way beyond an annual basis. Afforestation therefore requires the adoption of a completely different approach to risk assessment.

There is very little evidence to support accurate predictions of opportunity cost. Work on estimating the environmental cost of afforestation projects in developing countries is in progress, with some attention being given to the opportunity costs. Grainger (1997) outlined the basic principles of opportunity cost estimation and the five major factors to consider in afforestation schemes: income lost from agricultural production, the contribution of this income to national economic development, the specific contribution of this income to the economy of the region, the opportunity cost (or benefit) of not overworking agricultural land and of soil-rebuilding properties of afforestation, and the income and developmental benefits of afforested land.

Given these five factors, accounting for opportunity cost of afforestation becomes a challenging process, as there are both costs and benefits to afforestation and not all can be realized in the initial stages. Some of the costs (and benefits) affect regional, provincial, and national economies, and this accounting is contingent on the temporal and spatial factors in any afforestation scheme.

The Decision to Plant Trees

Farmers' attitudes toward trees are well studied. British research (Scambler 1989; Sidwell 1989) has examined why farmers value (or do not value) trees and has identified the factors involved in the decision to remove or retain trees on agricultural land. These studies specifically examined behavioral or attitudinal approaches to trees and grouped them on the basis of socioeconomic and cultural characteristics. The New Zealand literature has followed much the same pattern (Fairweather 1996), although this literature is slightly dated. This research consists mainly of survey analyses and uses a ranking system to examine reasons for planting trees. Fairweather (1996) has built upon this research and developed decision-making frameworks that model the factors considered when a landowner

decides to plant trees on private land. Although this research was conducted in New Zealand, it provides relevant reference for the current study.

Fairweather's (1996) decision frameworks indicate that economic assessments were important in all decisions, regardless of whether the assessments of long-term returns from forestry were positive or negative. Esthetic or environmental values did not compensate for economic feasibility in the short term, nor did potential for long-term return on investment. Fairweather's study is useful in its explicit examination of the economic aspects of decision making in this regard. The study also highlighted the constraints that prevented farmers who were favorably disposed to forestry from planting trees: need for immediate cash return because of cash flow issues, lack of time, and lack of money for establishment of trees. Forestry joint ventures and partnership arrangements may be able to address the last two of these issues, but the return on investment (and possibly the high cost of tree establishment) needs to be addressed with a financial incentive scheme.

Converging Results

The findings from the current study corroborate those from studies in other regions. The themes identified in the focus groups point to the important policy implications for an afforestation program and the incentives that will be required. The range of incentive packages and risks associated with afforestation have also been identified in other studies in North America, Europe, and the developing world. Additionally, many of the uncertainties with respect to carbon accounting, Kyoto Protocol compliance, and the economics of afforestation that were brought up in the focus group research are corroborated in the supporting literature.

The research findings deal mostly with indirect policy control mechanisms, and economic tools were cited as the most appropriate to encourage afforestation on private land. A summary of appropriate indirect control measures presented in the supporting literature encompasses the issues raised in the focus groups. Specifically, the focus groups identified market-based incentives, including taxes, subsidies, contracts, and tradable carbon permits, as the most important incentives, and these were also identified by Richards et al. (1997) as appropriate policy tools to encourage afforestation.

Tax incentives identified included a prorated land tax scheme and income tax adjustments to reflect end-of-cycle payouts or annual payments. The issue of subsidies for afforestation was an important point within the financial incentives theme and relates to the opportunity cost factors identified in the supporting literature. As cited in the supporting literature, these include lost income in the current year, lost market opportunities in the future, and changes in appraisal values of the land (either positive or negative). The research themes focused on the need to put a dollar figure on this opportunity cost and to use this dollar figure as the basis for subsidy payments. The difficulty of fully accounting for this figure in a given year, let alone projecting it over the life cycle of a particular tree crop, was outlined in the supporting literature. The most appropriate solution would be a subsidy with a range of values, depending on location, soil type, current land use, and other factors, and use of this subsidy as compensation for a variable opportunity cost.

The issue of carbon permits was discussed with the same degree of veracity and uncertainty as is available in the supporting documents. There was a great deal of interest in tradable carbon permits as a financial incentive for afforestation. The problems are a lack of knowledge and a lack of development of a carbon credit trading scheme; these issues must be resolved by both private and public sector players.

A variety of institutional incentives identified in the supporting literature mirrored the thematic results from the focus groups. Information and research or technical support were the most often identified needs, and these constitute an accepted policy incentive tool. Public education was not mentioned in the supporting literature but was discussed frequently by the focus groups as an important component in changing both landowner attitudes (regarding carbon sequestration and production) and urban and commercial attitudes (regarding carbon production). The public-good function of an afforestation program is an important element and must be emphasized in any program.

Market reform incentives were discussed often by the focus groups and were identified in the supporting literature as well. This complex issue relates to the general risk assessment that landowners must do when beginning a long-term afforestation scheme. The supporting literature

focused on the role of government in mediating market risk and market reform issues, whereas the focus groups emphasized private sector schisms and predictions, a difference that probably reflects the timber company ownership situation on the Canadian prairies versus other models in the European examples.

The key decision-making factors identified in the supporting literature also came out in the focus group process: risk assessment, land use, income, establishment, and opportunity cost. The current research builds upon that of Fairweather (1996) and emphasizes the role of economic factors in the decision whether to plant trees. Much of the supporting literature has focused on amenity factors, esthetic factors, and public-good factors. The research reported here found that the short-term economic factors were the most important, beyond the potential for long-term economic return and beyond other noneconomic factors. This reflects the context of the Canadian prairies: socially and economically, it is a depressed region and in this scenario, economic factors become paramount, even when long-term benefits seem to make reasonable sense.

This research adds to the literature on afforestation schemes in two important areas, by identifying the necessity of a multifaceted approach and the need to appropriately define marginal land. The thematic results of the focus groups clearly indicate that a "one size fits all" approach will not work across a region as diverse as the prairies. Regional differentiation in soil types, economies, and market access mean that a federal program must be flexible enough to adapt to regional conditions. This is almost at odds with some of the research by van Kooten (2000) which makes economic and area predictions based on monoculture planting of hybrid poplar across very large areas. Obviously suited to econometric modeling, this assumption is challenged by the results reported here, which means that many of the economic predictions must be made more sophisticated or contain a variety of outputs based on the different economic and institutional needs identified.

The need to consider both small-scale and large-scale afforestation schemes, also referred to as conservation and commercial planting, respectively, is the most significant area where the focus groups differed from the supporting literature. The focus groups agreed that any program should consider options over this range. However, this spectrum has not been considered in the supporting literature dealing with afforestation and climate change mitigation measures, although there has been considerable study of both conservation and commercial afforestation in and of themselves.

The need to define marginal land in a more complex manner also arose from the research reported here. This issue has been treated only superficially in the supporting literature, and the focus group participants had particular difficulty with the variety of definitions of this term. Marginal land means different things to different people, and the term should be dealt with more explicitly in future research and program delivery or replaced with a more suitable term.

SUMMARY OF ELEMENTS FOR A FEDERAL AFFORESTATION PROGRAM

Results from this study point to several key issues associated with the development of a federal afforestation program. These issues are summarized below.

Flexible Incentive Packages

Provision for Opportunity Cost

The opportunity cost varies by region and microclimate. Participants were reluctant to put a dollar figure on a particular piece or type of land because of the many factors that need to considered. (Various dollar figures can be found in the results for individual focus groups; see Appendix 2). There was a desire for financial incentives that would pay an annual return, perhaps based on a sliding scale over time, and a desire that this compensation be worked out on a regional or site-by-site basis. This approach would be consistent with the discussion as a whole and the desire for a regionally differentiated program.

Tax Incentives

The discussion about tax incentives focused on both tax rebates and tax relief. Income tax on the sale of timber at the end of tree life cycles could be amortized over the preceding years, and land tax assessments would have to be of an incentive nature (currently they are not).

Sharing of Risks

An afforestation program must be promoted on a risk-sharing basis. If delivery agents cover the costs completely, there is a risk of attracting "program milkers" (individuals who are not serious about afforestation or who are trying to make as much money as possible by manipulating the program).

Risk to the producer must also be shared or reduced. There is high risk of crop failure during tree establishment, and fire, insects, or disease in later stages of establishment could destroy the plantation after many years of investment.

Long-Term Commitment

The commitment from government must be consistent with the life cycle of the trees. Short-term programs that match political or fiscal time frames (e.g., 1 year, 4 years) would not adequately support afforestation.

Information and Infrastructure Support

More information is needed before participants would be willing to make firm commitments. A wide variety of information needs were expressed, and generally these had to do with growing, establishing, maintaining, and harvesting the trees. Infrastructure support would come in the form of appropriate technology sourcing and leasing or rental of machinery through delivery agents.

Grower's manuals, best-practices guides, and business planning tools were an immediate priority for all research participants, and it is recommended that these be researched and compiled.

Regionally Differentiated Program

Microclimate and Ecosystem Differences

The focus group participants were adamant that a "one size fits all" approach would not work in this situation. Differences in regional economies mean that different incentive packages would be needed for different regions of the prairies, and microclimate differences mean that different tree species might be best suited to different areas.

To get large areas planted and tree growth started within an adequate time frame, the trees would have to be planted on good-quality soil. All participants agreed that "good soil grows good trees" and that any large-scale effort should be directed at usable agricultural land. This focus on "good soil" would change the nature of incentive packages and program targeting. "Marginal land" was a controversial term, although there was some acceptance that conservation-type planting is needed. Aggregating areas of conservation planting would require program and monitoring flexibility.

Distance from Markets and Program Delivery Agents

The geographic situation of private landowners varies with respect to distance from major centers and from government delivery agents. Many are also located at great distance from potential timber markets or processing facilities. A distance quotient should be factored into any

financial incentive package, and such packages would have to consider inequities in access to transportation and communication.

Contingent Aspects

Carbon Credit Accounting

Most participants were interested in learning more about carbon credits and their potential role in an afforestation program. They felt that having more concrete knowledge about carbon credits would help in decision making. In some respects, carbon credits were seen as the "unknown element" and as a potential source of good income.

Cooperative Development

There was some suggestion that aggregating individual landowner acreages to account for carbon credits and to count carbon-sequestering acres would be a good idea. A program that provided this option would be viewed positively. Additionally, some incentive could be provided for the cooperative ownership of specialized machinery, with a buy-back option. Many landowners felt that they could not participate because of cash flow and acreage constraints, but they would be interested if a program could be structured to account for these constraints.

Timber Supply and Demand

Speculation on future timber markets and future demand for timber products is an area of great uncertainty that must be minimized through program planning. The management of an afforestation scheme on the basis of future timber profits represents extremely high risk, given current market conditions and volatility within the forestry industry, and most private agricultural landowners are risk-averse over the long term.

Parallel Research, Program Delivery, and Monitoring

Afforestation Research

Participants recognized the relative lack of research specifically targeted to afforestation schemes of this type and suggested that government departments should invest in research and education before they move toward specific strategies and programs. Existing examples of hybrid poplar plantations in North America could be a source for case studies or best practices. The general feeling was that these examples were not successful enough to justify an ambitious planting scheme across the prairies and that a systematic cost–benefit analysis remained to be done.

Delivery of Programs

Program delivery needs to be coordinated with local agriculture representatives and local agencies, instead of a separate delivery system being created. Most participants suggested that the delivery of programs would have to be well coordinated ("hands-on") because of the nature of afforestation on the prairies (a relatively new activity, with new infrastructure and a different knowledge base).

Monitoring of Results, Program Delivery, and Incentives

Proper monitoring of an afforestation scheme will be critical, especially given the high cost and labor inputs for establishment and the sometimes high mortality rates of young trees. Site assessment would be a good precursor to monitoring, but it was suggested that many landowners would not be the best judge of land quality for specific tree species. Some feedback mechanism is needed so that incentive packages can be evaluated.

Iterative Aspects

Because of the lack of experience in afforestation on the part of both landowners and government in Canada, any planned program must have an iterative planning aspect (through monitoring and evaluation). It is likely that adaptation will be needed, especially during the initial years of the program (before the first Kyoto compliance period), and improvements can benefit landowners as the program expands.

CONCLUSIONS

This report represents the results of intensive focus group sessions in the three Prairie provinces. The attitudes of private landowners toward a potential federal afforestation scheme and the incentives they would require to participate were the main focus of the research. The reason for this participatory research was the necessity of "on-the-ground" discussions about afforestation. A federal program of this type will be the first in Canada, and institutional support, technical and socioeconomic information, and delivery mechanisms are largely undeveloped and untested. This situation presents a good opportunity to gather the most relevant needs of private (agricultural) landowners with respect to afforestation.

The research examined the potential benefits and drawbacks of afforestation and considered the challenges and barriers to implementation of a federal program. Each focus group also discussed the necessary conditions for implementation of both small-scale and large-scale programs. Small-scale programs were defined as small plantations (less than 10 acres) and large-scale programs as plantations larger than 10 acres. The original terms of reference referred to afforestation on marginal land, but use of this term was problematic; therefore, analogous (and more accurate) terms were used at different points (e.g., "fragile land" and "conservation areas"). The focus group discussions also moved beyond a focus on marginal land, with the suggestion that good-quality trees and high-volume production for carbon sequestration could be achieved with good-quality land, as well as marginal land.

The literature reviewed during the secondary data collection provides a basis for placing this research in the context of other Canadian and international research on afforestation programs. Afforestation programs around the world have had variable success to this point. National and multilateral programs have been developed, and much effort has been directed to developing countries and areas of Europe that have had working forests for several centuries. Afforestation is one of several carbon management techniques, all of which should be considered by the federal government for carbon sequestration in the future.

Under the Kyoto Protocol, afforestation will potentially play a large role in carbon sequestration by the 2008–2012 compliance period. Different policy tools are available to encourage participation in an afforestation project, and direct and indirect control mechanisms are supported by economic and institutional incentives and regulatory development. The economics of afforestation in western Canada has been studied to a limited extent, with a primary focus on macroeconomic issues. Some practical scenarios have been examined, generally involving small pilot projects and expansion of acreage over time (because of real-world economic and technical constraints in the region). The estimation of opportunity cost for afforestation on private agricultural land needs development, and little guidance is available from the literature. The need to develop accurate but flexible analysis of opportunity cost is affirmed by the behavioral literature (examining decision-making factors), which emphasizes the primary role of short-term economic considerations in the decision to plant trees.

The results of the focus group sessions are presented both thematically and in summarized note form. The essential elements for a federal afforestation program were taken from these results and have been summarized in this report. In brief, flexible incentive packages must address opportunity cost, tax incentives, risk-sharing arrangements, the necessary long-term commitment by government and landowners, and the need for information and infrastructure support. A regionally differentiated program must account for microclimate and ecosystem differences and locational aspects of the prairie regions because of distance from delivery centers, markets, and support infrastructure. The contingent aspects of an afforestation program are the potential role of carbon credit accounting, cooperative development for both acreage and infrastructure development, and the uncertainty of timber markets in the future. Finally, there is a need for the development of parallel research, program delivery, and monitoring mechanisms. These include an increase in appropriate afforestation-related research, program delivery models, and monitoring techniques that are both participatory and reciprocal with program development.

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APPENDIX 1

Sample Template for Focus Groups

Manitoba Forestry Association

Overall Session Objectives – To determine landowner attitudes toward participating in an afforestation program to plant trees for the purpose of carbon sequestration and to determine what characteristics the program should have to attract landowner interest in being involved.

Time **Item**

10:30 **Introduction and Background**

- Introductions
- Background to the focus group sessions

Afforestation Issues

- Topic Objective: To discover and discuss the range of opportunities, challenges, and barriers surrounding afforestation.
- Sample Questions:
    - What is the value of afforestation to individual landowners?
    - What pitfalls are to be avoided in an afforestation program and how might they be avoided?

Small-Scale Afforestation

- Background information on small-scale afforestation
- Topic Objective: To have participants explore the potential of a small-scale afforestation program and what it would require for landowners to become involved in such a program.
- Sample Questions:
    - What has been tried in the past and with what success?
    - What are some of the factors that should be considered in a small-scale approach (e.g., planning timeline, size of farm, proximity to water, diversity of existing operation [including woodlots], skill or knowledge of the producer, technical support)?

Refreshment Break

Large-Scale Afforestation

- Background information on large-scale afforestation
- Topic Objective: To have participants explore the potential of a large-scale afforestation program and what it would require for landowners to be prepared to commit marginal land for the planting and growing of trees.
- Sample Questions:
    - What strategies are recommended to get buy-in to a large-scale program?
    - What type of incentives or assistance would be necessary or desirable from the landowner's perspective?
    - Who is most likely to take advantage of such a program? Why?
    - On what basis should it be decided that land is marginal and thus suited to the planting of trees?
    - What kind of government–landowner arrangement would be most supportive of a long-term program?
    - What would be the best way to put a dollar value on the use of private, marginal land?
    - If the government–landowner arrangement was a rental agreement, what dollar value would you put on your marginal land?
    - Who should own the trees when the program is over?

Most Critical Elements and Next Steps

- Reiteration of critical background; information on next steps in the process and follow-up
- Topic Objective: To have participants outline the minimum requirements of a successful afforestation program.

14:30 **Closing Comments**

- Opportunity for each participant to make a final comment
- Adjourn

APPENDIX 2

Detailed Focus Group Results

The focus group results are presented in seven tables, one for each focus group. The results were compiled from field notes, the facilitator's working notes, and supporting audio recordings. Each topic is supported by summarized points raised during the session. The notes provided to support the detail statements are paraphrased statements and discussion from the focus groups and have been summarized and amalgamated where repetition occurred. Direct quotes are indicated with quotation marks. Both the paraphrased comments and direct quotes have been included to best represent the nature of the focus group sessions and to allow closer examination of the discussion content.

Focus Group 1 La Broquerie, Manitoba

Topic	Detail	Notes
Benefits	Shelter belt provisions	Wider shelterbelts are a good idea
	Better utilization of wetter land	Unsuitable soil types could support trees
	Buffer formation, wildlife corridors	Wildlife habitat will improve the diversity at a regional scale
	Control of erosion	
	Wind protection	
	Income benefits from sale of timber	Land can produce better biomass
	Protection and enhancement of riparian zone	
	Diversification of income	Tree cuttings could be sold
	Utilization of small areas	Corners of fields, near fencerows, around buildings and other properties
	Moisture retention	
	Personal benefits	Self-satisfaction knowing that you are contributing to the environment
	Future opportunities for integration with agriculture	Tree production could be integrated with manure management plans from hog operations in the southern part of the province
Drawbacks	Defining marginal land	How some agencies evaluate marginal land is outdated, given new agricultural opportunities
	Potential loss of land to landowner	
	Lack of current tax breaks	
	High-risk speculation on future wood sales	Value of hybrid poplar unknown
	Long-term cycle for afforestation	You are locked in for the life of the crop
	Technical requirements	Planting and establishment are big challenges
	Economic uncertainties	The economics of afforestation on private land is critical to its success, and there is not enough of an economic picture to make decisions yet
	Livestock versus cropland	Most land in this area is livestock-based, which will put pressure on marginal land for pasture; trees and livestock are not compatible
	Increase in wildlife and associated damage	Increase in livestock or pest habitat
	Labor-intensive production	
	Urban-rural confrontation	Planting trees in rural areas to sequester urban carbon emissions; the farmer is saddled with management again
Barriers and challenges	Regional differences in land evaluations	
	Amenity value of afforested land may attract urban dwellers	An influx of urban residents would change the culture and nature of rural areas
	Attitude change required	Changing the nature of what it means to be a farmer
	Uncertainty of future markets	Requires a different management scheme for each end use
	Technical barriers to afforestation: planting, establishment, etc.	
	Suspicion of both government programs and environmental causes	
	Program participation	A program's success will turn on the number of participants or the number of acres, so it has to be economically viable and widely adopted
	Public education at different levels	

Focus Group 1 La Broquerie, Manitoba

Topic	Detail	Notes
	Program must be politically recognized and long-term	Government investment must be long-term and not on political whim
	Potential and scientific uncertainties	We need an assessment of the value of trees versus the value of alfalfa or other forage crops for CO_2 sequestration
	Insurance programs not available	There would have to be some sort of insurance scheme to cover the risks, including fire, of this long-term investment
Small-scale programs	Conservation-type planting	Small-scale versus large-scale afforestation is a bit unclear – you should call it conservation-oriented afforestation versus commercially-oriented afforestation
	Need for cash incentives	
	Technical requirements for establishment	Start-up and maintenance will require equipment, education, and labor components that should be a part of an incentives package
	"Program milkers"	"Program milkers" are people who would take advantage of any financial incentives and not really do the work
	Need for inspectors	
	Municipal – federal relations	If this is a federal program, a rebate would be a better incentive so taxes don't come out of municipal pockets
Large-scale programs	Loss of flexibility	Treating trees as a crop, but with long-term cycles
	Contract growing possibility	Lease or prepurchase of trees
	Risk assessment	Cannot predict far enough ahead to sign long-term contracts; e.g., future timber markets; future international agreements
	Partnering possibilities	Getting investors to put up money (partner) with farmers to plant trees; money for cuttings, weed control, land rental
	High establishment costs	~$500/acre to get trees established, ~$350–400 per acre in the first year (this is a big disincentive)[a]
	Opportunity cost	Figures and estimates vary depending on the region, previous use of land, quality of soil, climate change, etc. In this area it could be >$20 per acre for pasture, $80/acre for alfalfa; Steinbach area would be $40–60/acre no matter the crop
		For grazing land, the price per acre depends on the price of cattle
	Location for success	You will have to choose the right land to see results – not just any land will support trees
	Other tree species	Planting for nutraceuticals, high-value tree products (e.g., sea buckthorn)
	Program arrangements for landowners	Straight rental
		Forward contracts (different rates)
		Sharing of costs all the way through
		Speculation only (no cost-sharing)
		Can't see one program type fitting everybody
		Sharing of risks and benefits will filter out the people that aren't serious
	RRSP[b] model	One idea would be to use this program as a way to help retiring farmers put their land to a longer-term use that requires less labor and would provide income over time during their retirement years

[a]1 acre = 0.4 hectares.
[b]RRSP = registered retirement savings plan.

Focus Group 2 Brandon, Manitoba		
Topic	Detail	Notes
Benefits	Erosion control, water and snow retention	Rebuilding of soil in poor or marginal areas
	Provision of habitat	Potential shelter for domestic livestock
	Increased value of land	
	Cash crop potential	
	Reduction of annual farming costs	Annual inputs would be much less when amortized over the life cycle of trees, compared with grain
	Esthetic value	
	Heat units	Improved heat units for crops, retain soil temperatures
	Transition program	An afforestation program may provide a good transition from active farming for aging farmers
	Resource development	The development of a renewable resource base on the prairies
	Local habitat diversity	
Drawbacks	Weed control	
	Labor requirements	
	Opportunity costs	"Taxes to be paid, land payments have to be met, input costs are high and all up front, stump clean-up when it's all over" "Is this a rich man's program?"
	Fire and disease risks	
	Infrastructure	Small machinery needed is not often available and not owned by farmers
	Long-term returns	Banks are not favorable to providing financing for unknown or long-term returns
Barriers and challenges	Information needs	See small- and large-scale programs
	Current thinking	Grain farmer mentality: "What will the neighbors think?"
		A lot of farmers are still trying hard to remove any trees
	Government controls and regulation for a program	Government involvement often leads to program inefficiency
	Perception problems	Perception that an afforestation program is coming from tree huggers
	Insurance	Lack of experience or programs by insurers
	Site preparation	Need adequate soil sampling and land preparation for trees
	Education	Education of farmers, education of other private landowners, education of Canadian public about the need
	Financial return	Unknown financial returns and economic benefits; need to show success stories; marketing is critical
	Time conflicts	Trees often require establishment care at the same time as other farm crops
	Incentive packages	Financial incentives need to go down to the landowners, and programs should not be "top heavy"
		Inefficient programs often waste money, with payments going to those who know how to use the system
		Cash flow throughout the life of the program?
	Other tree species	Need to consider best tree species for soil type, microclimate; fruit trees may be better in some areas
	Loss of farmer control	There are many current conservation programs that deliberately remove control of private land from private landowners; "We don't want this program to do that"

Focus Group 2 Brandon, Manitoba

Topic	Detail	Notes
	Establishment	The science and economics of establishing hybrid poplar plantations are not well known as it has not been done consistently in Canada; CFS[a] and PFRA[b] simply do not have enough experience or replication to reduce the risk
Small-scale programs	Information needs	Grower's manuals, establishment information, soil type information, machinery information, market information
	Financial incentives	Financial incentives (e.g., per acre) to cover some costs in first 3 years of establishment Possible tax benefit (land taxes) Give landowners some carbon credit options?
	Program questions	Who owns the trees at the end of their lifetime? Are there going to be trade or WTO[c] issues with subsidies? Are there possibilities for private – public partnerships? What are other countries doing in this regard? What are private companies doing in this regard? (ALPAC[d] is currently doing rental arrangements for afforestation)
Large-scale programs	Incentives	Landowner must retain control of land – "right of first refusal" Contracting on the value of trees (per tonne, etc.) (NB: every point from discussion of small-scale programs also applies to discussion of large-scale programs)
	Cooperative arrangements	3 or 4 farmers could get together with a quarter of land to share risks and costs
	Land requirements	"You need good land for good trees" Marginal land would only work for conservation-type afforestation and may not provide the carbon sequestration potential that a government program desires
	Location	The location of tree plantations has to be amenable to maintenance and harvest The distance from potential markets is also an important factor
	Opportunity cost	Needs to be calculated, perhaps on a sliding time scale, for different regions of the prairies, and depends on soil type
	Definition of marginal land	The definition of marginal land really depends on current markets for agricultural products and it's very relative (i.e., DU[e], grain farmers, hunters, foresters have different perceptions of marginal land) Marginal land, in the true sense, may be too marginal for trees
	Types of arrangements	A continuum of arrangements, from the producer taking all risks and benefits from sale of timber and carbon credits, through cost sharing and benefit sharing, to government rental of land
	Unknown factors	What are the long-term effects of large hybrid poplar plantations on the ecosystems of the prairies? Is it similar to monocropping of cereals in North America or oranges and bananas in tropical regions (e.g., vulnerable to disease, drought)?

[a]CFS = Canadian Forest Service.
[b]PFRA = Prairie Farm Rehabilitation Administration.
[c]WTO = World Trade Organization.
[d]ALPAC = Alberta-Pacific Forest Industries Inc.
[e]DU = Ducks Unlimited.

Focus Group 3 Dauphin, Manitoba

Topic	Detail	Notes
Benefits	Ecosystem benefits	Improvement of soil control, moisture retention, water quality, wind erosion, snow retention Act as natural filters for nutrients and runoff Habitat for insects, birds, wildlife Less chemicals used on the land? (depends on establishment methods)
	Provision of shelterbelts	
	Income potential	
	Care of marginal land	Neighbors are appreciative of marginal land care because of noxious weeds, etc.
	Diversification of income	Less vulnerable to markets for agricultural products
	Reduction of chemical inputs to land	
Drawbacks	Opportunity cost	Taking productive land out of revenue generation (over short-term)
	Maintenance and establishment costs and labor	
	Harvesting efforts and costs	Who will be able to do the harvesting, especially if many participants are doing it at once?
	Weed control	High costs and labor required
	Habitat	Pest and weed propagation
	Management	Management on a large scale is going to be a nightmare and will have to be well organized (program delivery will have to drastically improve over current and previous programs)
	Infrastructure	Most large-scale farmers would not have any of the appropriate equipment for planting trees
	Biodiversity	Monoculture plantings of hybrid poplar will not increase biodiversity
Barriers and challenges	Lack of information	
	Perception of "farmers" and "farming"	Many landowners are very entrenched in their ways Many farmers also think that trees are a nuisance and knock them down whenever possible
	Program coordination	Lack of coordination between government people and producers; delivery agents are not good
	Transparency	Need to have cost-benefit transparency in terms of sustainability (financial, environmental, etc.)
	Country benefits, producer pays	Trees may not meet the economy of scale needed for each landowner to make a profit (grain farmers currently operate on a very large economy of scale)
	Education	Sell the benefits of afforestation to the general public
	Planting schemes	Are we looking for a mature working forest with a complete life cycle in one area, or are we looking at it like a crop?
	Incentives	Tax relief or tax credit for grain farmers to plant corners or fields, near riparian or irregularly shaped areas
Small-scale programs	Information needs	Machinery needed and machinery available? How many participants would a successful program need? How to establish small-scale plantings (e.g., landscape design, weed control, maintenance, mortality rates) Which trees would be most suitable for various soil types?
	Alternative focus for afforestation schemes	Look at municipal land and land within conservation districts that is not being used (e.g., examine road allowances for afforestation) Examine PFRA[a] areas for planting (e.g., community pasture areas, government leased land)

Focus Group 3 Dauphin, Manitoba

Topic	Detail	Notes
Large-scale programs	Information needs	Similar to small-scale program needs but to a much greater extent: -establishment costs -weed control, maintenance requirements -landscape design -sourcing of trees -business plans for successful operations -infrastructure requirements
	Incentives and assistance	Need to have an economically viable program (e.g., compete with cereal crops or cattle)
	Marginal land	Is it large scale on marginal land? Probably need good land for large-scale production, or the risk assessment will be too high
	Infrastructure needs	A large planning infrastructure will be needed to support large-scale afforestation schemes – this will have to be developed over time
	Economic planning	"The numbers have to pencil out for anyone to seriously consider putting a lot of land into trees"
	Carbon credits	The ultimate role and value of carbon credits needs to be determined; this may have a role in decisions to afforest land and will affect the return on investment
	Opportunity cost	Valuing of land will be difficult – it varies region to region
	Intergenerational issues	What happens to the land when it is sold? There could be an option for inheriting afforestation agreements, but don't want caveats on the land
	Perception issues	Public perception of afforestation will have to be improved with education, perception by landowners will have to change from "tree hugger program", and rural – urban conflicts will have to be minimized
	Early innovators	Any large-scale attempt at afforestation across the prairies will have to go beyond targeting the early innovators

[a]PFRA = Prairie Farm Rehabilitation Administration.

Focus Group 4 Yorkton, Saskatchewan		
Topic	Detail	Notes
Benefits	Ecosystem benefits	Shelter for livestock, land, wildlife
		Erosion control
		Water and snowmelt retention
		Marginal farmland can be kept covered and the soil protected
	Kyoto benefits	Carbon sequestration
	New income source	
	Soil-building properties	Marginal land can be stabilized and covered, and soil rebuilding can occur with the right management scheme
	Structural diversification	Farm-level diversification of income sources
	Regional benefits	Long-term investment is good for the region as a whole
	Generational benefits	Future generations will benefit from increase biodiversity and treed landscape
Drawbacks	Sustainability aspect	How much fossil fuel energy is required to establish a plantation? "Does it really provide an overall benefit to the environment, or are we taking from one hand to feed the other?"
	Labor-intensive	Manual labor required for establishment, especially for small-scale plantations
	Operational issues with large grain farms	Trees are often cleared for equipment access and turnaround space
	Lack of short-term income	
	Rotational time frame	In this region of Saskatchewan hybrid poplar takes at least 20 years (20–30 years normally) to reach maturity
Barriers and challenges	Information needs	All growing and maintenance information is needed (analogous to grower's manuals for certain crops)
		Harvesting information
		End-use information
		Agronomic and technical aspects of growing hybrid poplar are not well known
		Cross-jurisdictional issues with government research on these aspects – there is not much information sharing or awareness of one another's programs
	Cost of establishment	
	Market speculation and risk assessment	Pricing and demand for timber products in the future is unknown
		Carbon sinks may have speculative value in the future
	Establishment costs	First 3–5 years require high input costs
	ROI[a]	The length of time for ROI is long, and a long ROI is not normal business practice for most private landowners
	Critical size of plantation	For planting and harvesting to be feasible at an efficient economy of scale, a certain size of plantation will have to be established
		Large contractors will only harvest large acreages of trees
	Rotation systems and management needs	Appropriate rotation systems for trees and best management practices will have to be established
	Locational challenges	Deciding on which tree species is most appropriate for which area and which soil type is important
		Relative location to future markets and future harvesting and processing infrastructure is also important

Focus Group 4 Yorkton, Saskatchewan		
Topic	Detail	Notes
	Opportunity costs	Setting appropriate compensation or incentive schemes based on opportunity cost will be necessary Some combination of this with carbon credit valuation would also be possible
	Fall-down effect	Second generation of trees will probably be good only for minimal pulp (i.e., hybrid poplar is not necessarily part of a working forest scheme)
	Crop comparison	Carbon sink potential of a unit of hybrid poplar versus a unit of canola or a unit of alfalfa?
Small-scale programs	Lack of equipment, infrastructure	Especially for small landholders and hobby farmers
	Establishment time and costs	You need to fallow for 2–3 years to prepare soil for trees
	Information needs	Similar to those mentioned in section on barriers and challenges Weed control issues – mulching on small acreages versus spraying or tilling on large acreages Tree varieties and selection is critical and dependent on soil type and microclimate Best-practice information for weed control is needed
	Good soil, good trees	If you can't grow crops on a piece of land, trees won't grow either
	Herbicide licensing	Agricultural license for herbicide is different from a license for use on trees
	Valuing conservation land	There currently is no compensation for set-aside land, no tax incentives for land conservation
	Education needs	Need an awareness program to educate landowners about forestry, marketing, logging, reforestation, afforestation, etc.
Large-scale programs	Information needs	Similar to the above topics: -machinery requirements -market niches, demands in the future -carbon credit accounting Need good business plans for different sized operations
	Economics	Case studies and successful business plans will have to be made available If the economics work out, then many people would adopt an afforestation program on their land
	Financial incentives	Have to be as good as cash rent (opportunity costs) Wary of financial incentives that are not properly developed or delivered (a few large producers get a lot of assistance because they can access or leverage programs, and many small landowners get nothing) It's possible that carbon credits could become quite valuable and provide a viable means and incentive for financing afforestation on private land – this would push afforestation away from government programming
	Insurance needs	Insurance schemes for tree crops are needed
	Possible market ideas	Scandinavian example of selling standing wood at auction – this idea might work here, as there is sure to be demand for wood in the future (helps eliminate some harvesting risk and uncertainty)
	Regional approach	Groups of farmers, in a cooperative manner, could plant large acreages, thereby providing the economy of scale to bring in planting and harvesting infrastructure

[a]ROI = return on investment.

Focus Group 5 Saskatoon, Saskatchewan		
Topic	Detail	Notes
Benefits	Ecosystem benefits	Protection from wind and water erosion
		Snow retention and increased snowmelt benefit to soil
		Habitat provision for wildlife and domestic livestock
	New income source	Financial return for carbon credits or through incentive packages
	Farm diversification	New income sources from afforestation, potential for eco- or agri-tourism through afforestation
	Esthetic value	Improving land values through the improvement of esthetics
	Soil husbandry tool	
	Regional development and economies	Improves the economic outlook of whole regions if plantations are successful and adopted on a large enough scale
	Marginal or abandoned land solution	Excellent opportunity to provide long-term care for marginal land areas
	Water quality	Natural filter system; could provide good benefit for hog barns and other intensive livestock operations
	RRSP-type[a] potential	Long-term income source may provide some intergenerational transition solutions or retirement solutions
		Allows farmers to do some long-term planning which they cannot do at the moment
	Reduced input costs	Amortized over life cycle of trees
Drawbacks	Over regulation	Too much government control on a program could turn people off
	Habitat for nuisance wildlife	
	Establishment costs	The first 3–5 years of input cost are quite prohibitive for most people
	Long-term ROI[b]	Long-term realization of income will deter many people – too risky
	Disease or fire outbreaks	Insurance will have to cover this, and new programs would have to be developed
	Liability issues	Who owns the below-ground carbon?
		Who owns the carbon credits?
		What happens if the program fails, or if the trees become diseased or infested with pests (monoculture risks)?
	Taxes	Need to reduce taxes as incentive
	Labor inputs	High manual labor requirements
	Infrastructure limitations	Small machinery and specialized machinery is not readily available and not owned by many landowners
	Financial and mental burn out	Making land and mortgage payments, off farm jobs – many do not have the means or energy to break the income cycle
Barriers and challenges	Byproduct use	Ethanol or hog fuel plants could use thinnings, etc.
	Information needs	Need more information to make concrete decisions: -market information -grower information -don't want to "reinvent the wheel", so case studies and success stories are necessary -identify partners (in private sector) who could help manage an afforestation program -information packages should encourage those who are not typical innovators (get broad support)

Focus Group 5 Saskatoon, Saskatchewan

Topic	Detail	Notes
	Establishment challenges	Costs and knowledge about tree establishment are a big barrier and challenge to those interested in afforestation
		"You're assured the work, but not the income"
	Opportunity costs	The numbers given different agricultural production schemes have to be established; these vary quite a bit by region and microclimate
	Polyculture	Polyculture instead of monoculture hybrid poplar? Is our goal a mature working forest for carbon sequestration?
	Long-term commitment from government	Commitment has to match the life cycle of trees and not just political term
	Marketing	Individually and cooperatively, determination of end use will affect management strategy and selection of tree species
	Knowledge accumulation	We need a method of collecting information that is beyond the traditional academic or government formats
		There are many people on the prairies right now that have afforestation experience and we need to get their stories
	Carbon sinks	The value of carbon sinks should be well established so that any economic opportunities are best realized
		Role of private business in the buying or selling of carbon credits is also important – need to clarify their potential role
	Value of carbon sinks	Need to distinguish (quantitatively) the difference between forage as carbon sink and trees as carbon sink – also the carbon emissions from cutting trees versus the emissions from summer fallowing or cutting crops
Small-scale programs	Information needs	Where to get stock
		How to establish a planting
		How to space trees
		How to control weeds
		Maintenance over time
		Different options available depending on species, size of plantation, etc.
		"Grower's guides" would be a good initiative
	Incentive options	Free trees, carbon credit options, sharing of establishment costs, profit sharing on harvesting
	Partnership opportunities	With conservation groups, private forestry businesses, community organizations that want to plants trees, schools and educational institutions, etc.
	Role of agriculture representatives	Agriculture representatives could link up and down with farmers and delivery agents
	Role of economic benefits	For small-scale or conservation-type planting, many participants would participate based on break-even finances and rely more on the less tangible benefits of afforestation
	Scaling up of efforts	It may be difficult to get enough small-scale or conservation-type plantations on marginal land to provide enough acres to satisfy the goals of the program or of Kyoto; large-scale plantation on good-quality soil would be needed
Large-scale programs	Environmental farm plans (agriculture policy framework)	Would a potential afforestation program tie in with environmental farm plans, which are going to be mandatory soon?
	Sharing or risks	Landowners must have some risks (financially) if the program is to succeed or else you will get "program milkers"
		Incentive packages must assist participants but not provide free services or income

Focus Group 5 Saskatoon, Saskatchewan		
Topic	Detail	Notes
	Information needs	Similar to small-scale needs but need even more marketing information
	Landowner commitment	This commitment is critical to the success of the program – can't have people pulling out after 5 years
	Progressive planting options	Planting 10–20 acres per year would help spread costs and risks over time
	Case studies	We need to see how people have done this successfully (or not) previously
	Social utility and responsibility	ROI may not be until the next generation but that is a good argument for this type of program (improve the sustainability of agriculture)
	Opportunity cost	Many areas of Saskatchewan would have opportunity costs of $20–25/acre because of the agricultural situation You can't make that number universal however One idea would be to eliminate the quote per acre for opportunity costs and give a quote per land type or quote per growth unit and have this assessed and re-evaluated every 5 years "But this will not cover the cost of establishment ($1 000–1 200/acre) in the first years"

[a]RRSP = registered retirement savings plan.
[b]ROI = return on investment.

Focus Group 6 Athabasca, Alberta

Topic	Detail	Notes
Benefits	Diversification of farm operations	Income diversification, diversification of planning horizons, crop diversification
	Increase in land values	Esthetic role of trees would increase land value
	Ecosystem benefits	Soil protection, water protection, wind and erosion control
		Improvement of water sources
		Soil-building properties of trees
	Possibility for retirement income	Timber harvest income
	Possibility for steady income	If a program is set up for annual financial incentives
	Transitional strategy	Keeping land within farm families is tough, and this program may provide a means to do that
	Employment	Local employment possibilities for maintenance
Drawbacks	ROI[a] time frame	Long-term ROI is a hindrance to many landowners with immediate cash flow needs
	Land-use conflicts and landowner attitudes	Traditionally farmers have been knocking trees down, draining swamps, etc.
		This type of program flies in the face of these perspectives
		"My grandfather cleared this land and I'm not putting a tree back on it"
	High cost of establishment	
	Weed control	
	Fire and disease risk	Especially from hybrid poplar plantations, which are effectively a monoculture crop
	Tax issues	Tax assessment on woodland is higher now and would have to be adapted for incentive purposes
		There could be an amortization of income tax for harvested product over the preceding growth years
		A need for a capital gains exemption for intergenerational transfer
	Long-term leases on land	Long-term leases (20, 30, or 40 years) often have unexpected drawbacks (e.g., road allowances in land that would get developed, change in government policy)
Barriers and challenges	Time frame	The long cycle of hybrid poplar (15–20 years) and subsequent ROI is a challenge because of cash flow issues
	Financial incentives	Tax relief programs
		Monetary compensation for establishment costs
	Regulatory roles	Municipal versus provincial or federal regulatory roles?
	Rights of other land users	It's important to consider the rights of other land users such as oil and gas industry, mining
	Regulatory uncertainty	The direction and ratification of Kyoto is still unknown
		The role of US policy with respect to climate change may be an important factor
		Uncertainty of the project (if and how long it will continue) is a big barrier for adoption of afforestation
	Need for more information	Need information about growing trees, marketing, etc.
	Need for regional differentiation of program	"One size fits all" type of program will not work across the prairies
	Ownership of carbon credits	Above-ground and below-ground carbon?
	Lack of appropriate research	There is no good research available on woodlot management with afforestation as a crop (i.e., hybrid poplar)
		Need some best-management practices

Focus Group 6 Athabasca, Alberta		
Topic	Detail	Notes
	Markets	A lot of the market control in forestry (as in beef and grain) is not in the hands of producers – afforestation could be another form of dependency on large market players
	Integrating industries	Traditionally forestry and agriculture have been very separate – we are trying to blend or amalgamate the two industries and this could have institutional and developmental problems (and perception problems)
Small-scale programs	Species available	Are there options besides hybrid poplar for both small and large plantations, species that may be more appropriate for soil type?
	Site preparation and tree establishment	The ground would have to be prepared and left fallow and weed-free for a couple of year before planting Planting and maintenance requirements would also have to be provided to program participants
	Aggregation of small areas	Will it be possible to add small plantations and even shelterbelts or windbreaks together when counting carbon sequestration acres?
	Information needs	Soil type information, management schemes, weed control and establishment practices (best practices or grower's manuals) Markets for small volumes, business planning scenarios for both small- and large-scale plantations
	Financial incentives	Cost-sharing for establishment period
	Contract arrangements	Long-term leasing of land by government Program enrollment with incentives paid out over a number of years Contracts must be established with the tree life cycles in mind
	Infrastructure and technical assistance	Machinery requirements need to be known, and sourcing assistance would be beneficial Technical assistance in the development of appropriate fencing strategies, site preparation, etc.
Large-scale programs	Fire protection and insurance provision	It will be necessary to have fire protection equipment and insurance policies because of the huge investment and high risk
	Information needs	Similar to those for small-scale programs, but to a greater extent Need to know all silviculture information One idea would be the development of grower's manuals and business planning or best practices manuals for interested participants
	Incentive and assistance packages	Assistance could come in the form of site assessments, soil testing, etc. Incentives would be both informational and financial Financial incentives would include cost-sharing packages during establishment (covering opportunity costs) and tax relief or rebate programs
	Carbon credit accounting	The value and potential of carbon credits needs to be better established so that landowners can factor this into decision making
	Polyculture possibilities	Monoculture versus polyculture plantations? (Is this an option?)
	Management arrangements	Grower sell-back arrangements such as that of ALPAC[b] Long-term lease arrangements Landowner speculation

[a]ROI = return on investment.
[b]ALPAC = Alberta-Pacific Forest Industries Inc.

Focus Group 7 Peace River, Alberta

Topic	Detail	Notes
Benefits	Reduction of input costs	Once the cost of establishment is covered there are considerably lower input costs
	Ecosystem benefits	Ecosystem integrity, wind and erosion protection, retention of snowmelt and spring runoff, wildlife habitat, increased biodiversity
	Recreational opportunities	Cross-country skiing trails, summer use, etc.
	Source of income	
	Good use for marginal land	Doesn't grow crops Rocky land, soil quality is poor Small fields that equipment cannot turn around in Frost-retention areas (early frosts in late summer, late spring frosts)
	RRSP[a] potential	A source of retirement income or income layaway
	Intergenerational transfer	
	Increase in land value	Through esthetic improvements
	Soil-building properties of trees	More productive forests and productive soils with the use of polycultures and companion planting; some agroforestry initiatives are good examples
Drawbacks	Initial establishment costs	
	Infrastructure costs	Small machinery is not readily available or owned
	Opportunity costs	Need to be compensated for this through cash or tax incentives
	Changes the nature of agriculture	"Changing the face of agriculture on the prairies, changing what it means to be a farmer" "Producing fiber and not food"
	Increase in wildlife problems	
	Source of trees	Is there going to be enough supply for a large-scale problem? "How long will it take to ramp up the nurseries to supply this many trees?"
	Return on investment	The long time frame for ROI[b] is not conducive to current management practices
	Labor intensive program	
Barriers and challenges	Marginal land issues	Marginal land can mean marginal trees Use of the term "fragile land" may be a better option
	Climate change factors	Many of these are unknown and will or can affect tree growth and establishment
	Silviculture knowledge	"It seems like forestry is 20 years behind agriculture in terms of agronomic knowledge"
	Public education	There is a public mind-set against hybrid trees (people think they are GMO[c]); we therefore need education and awareness-raising
	Incentives	Need for financial incentives such as tax breaks and payment per year for establishment costs
	Management plans	Best-practices manuals and business planning tools needed
	Risk-sharing	Need to find the right combination of risk-sharing so that you get dedicated program participants
	Weed control, pest control, fire control	These issues are major challenges and should be addressed with management planning
	End-use considerations	Speculation on final markets is risky – what is the best approach?
	Information needs	A lot more information must be provided before anyone can make a firm commitment: -grower's manuals -business plans -market information -Kyoto confirmation and information -carbon credit information

Focus Group 7 Peace River, Alberta		
Topic	Detail	Notes
	Trees versus forage	What is value of hybrid poplar for carbon sequestration versus that of forage crops or other shrubs, cover crops, new species, etc?
	NTFPs[d]	Is there a role for NTFPs in a polyculture or working forest? Can we add value to an afforestation scheme beyond just the value of trees for timber or carbon sequestration?
	Partnerships	Need to explore all of the possible partnership arrangements, with industry and with government
Small-scale programs	Program flexibility	This is a requirement as small-scale or conservation planting will have very different site circumstances
	Information needs	-site requirements -species requirements -density -cost and benefit of particular species -best management practices -how to maintain stock (before planting) -weed control, pest control, wildlife management (e.g., grower's manuals) -impact on adjacent agricultural land
	First right of veto	Need to retain control of private land
	Tax breaks	Land and income tax breaks or rebates
	Economic planning	The economic planning for small-scale is much different than for large-scale plantings (where profit is key)
	Infrastructure support	Some sort of assistance or cooperative development to obtain and use specialty equipment
Large-scale programs	Joint venture idea	Private landowners could act as managers over larger blocks of trees in conjunction with private business (e.g., ALPACs[e] afforestation program)
	Information needs	Same as for small-scale programs
	Opportunity cost	Needs to be financial incentives to cover the opportunity costs Minimum for grazing land in this area is $25/acre per year Central Alberta is still $50/acre per year Forage land in Alberta is $30/acre per year Need to be flexible with the rates
	Complementary programs	An afforestation program should complement other reforestation efforts, at least for public image reasons

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Topic	Detail	Notes
	Management plans	Need detailed and comprehensive management plans available to prospective program participants -what land to use -how to prepare sites -secondary opportunities for trees -water proximity and requirements -soil and microclimate limitations
	Practice change	"Afforestation is being pushed because it is a practice change – agricultural land is already sequestering carbon, but the argument is that afforested land will sequester more carbon; in this case, carbon credit would be given on the difference"

[a]RRSP = registered retirement savings plan.
[b]ROI = return on investment.
[c]GMO = genetically modified organism.
[d]NTFP = nontimber forest product.
[e]ALPAC = Alberta-Pacific Forest Industries Inc.